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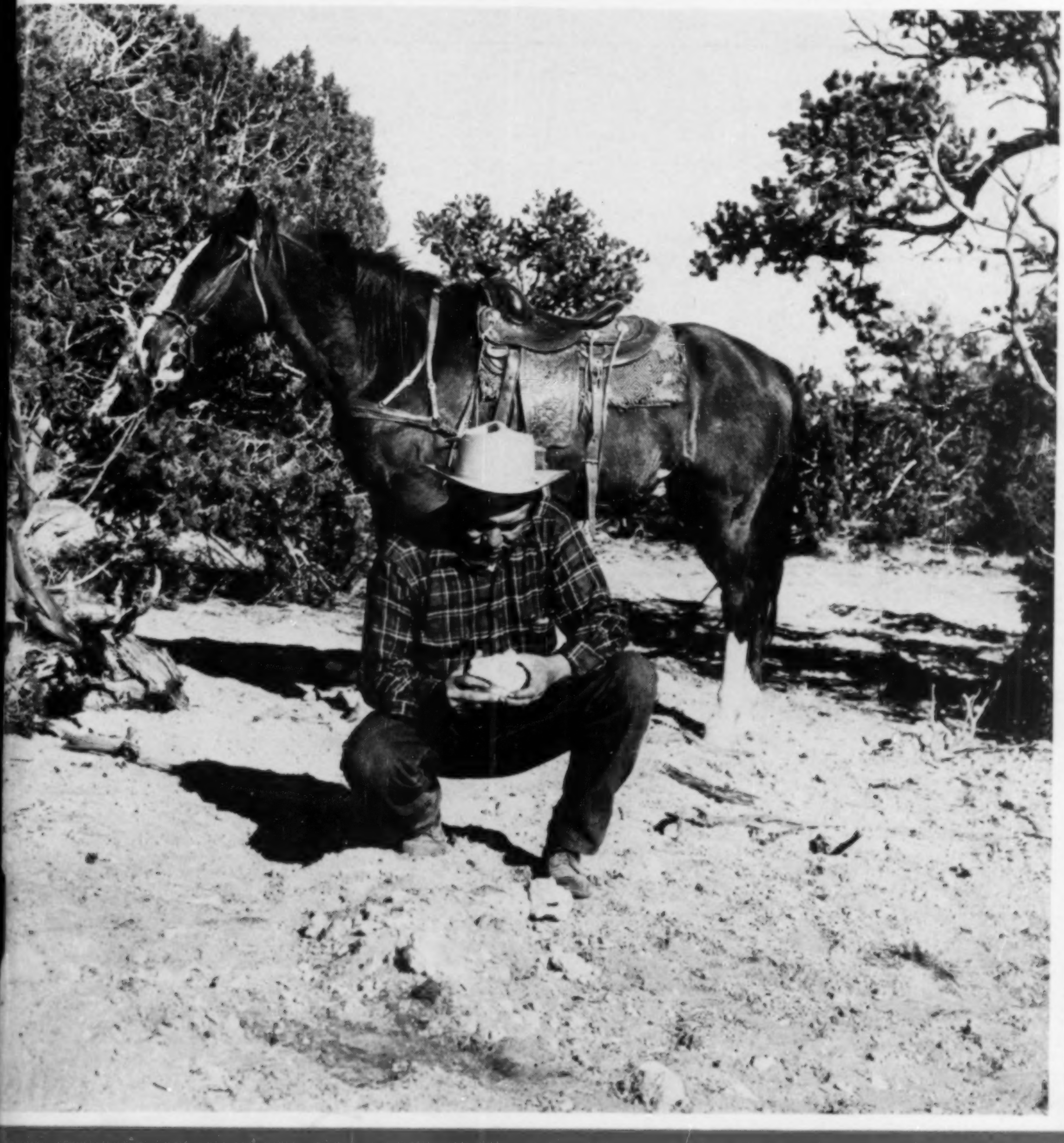
Compress

OCTOBER 1951



PADDY MARTINEZ AND HIS URANIUM

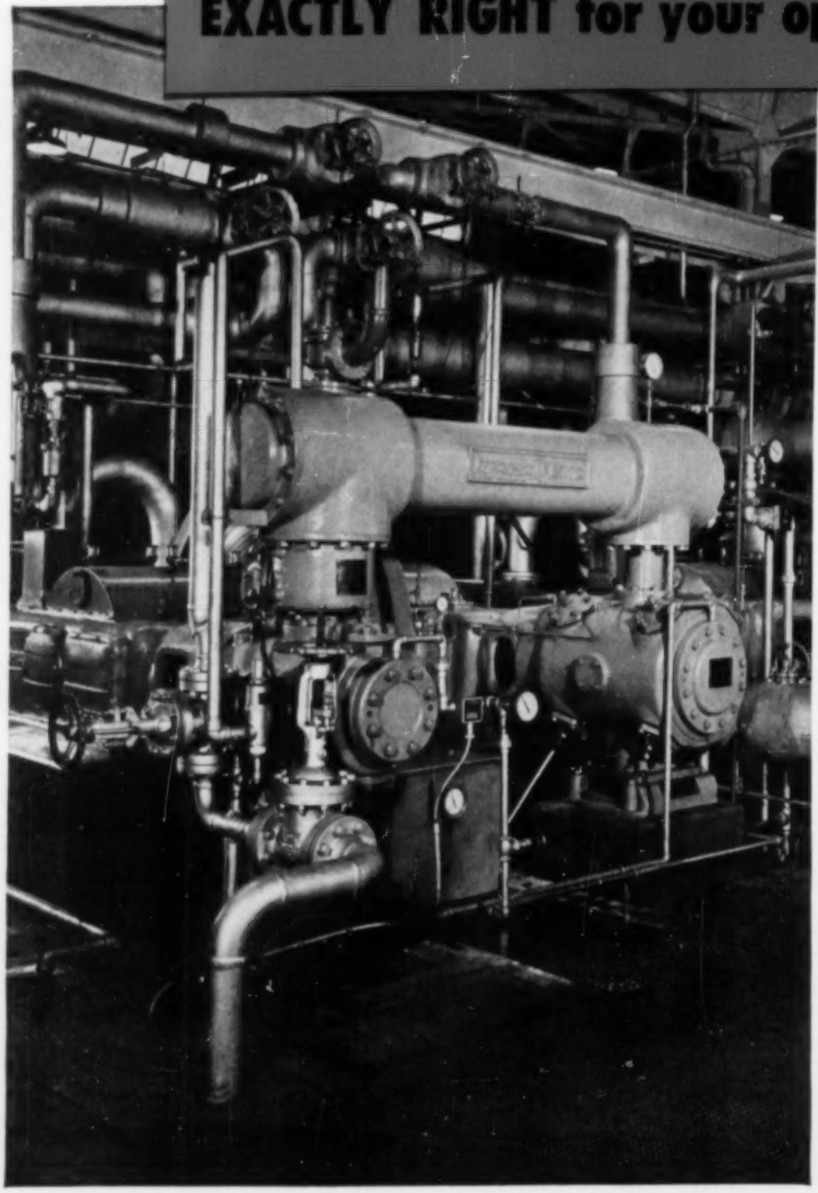
Sheep raiser reënacts find he made on land owned by the Sante Fe Railroad

(SEE INDEX PAGE AND PAGE 267)

VOLUME 56 · NUMBER 10 NEW YORK · LONDON

REDUCE AIR COMPRESSOR COSTS

USE the Texaco air compressor oil that's EXACTLY RIGHT for your operating conditions



No one can expect *one* oil to assure top performance under *all* operating conditions. So choose the lubricant that's *exactly right* for your set-up. You'll find it in the complete line of Texaco air compressor oils. For example—

★★ When conditions are causing rust in cylinders, coolers, lines or receivers, you can eliminate it with a Texaco *rust-inhibited* air compressor oil.

★★ When conditions of severe service are causing carbon and gum to form, you can avoid the difficulty with a Texaco *heavy-duty* air compressor oil embodying special detergent and oxidation-resistant properties.

★★ When conditions are causing condensation in cylinders, you can overcome the washing effect of the water and guard properly against wear by using a Texaco *compounded* air compressor oil.

★★ When conditions are "normal," a Texaco *straight mineral* air compressor oil will assure clean operation and reduce wear.

Let a Texaco Lubrication Engineer help you select the proper Texaco air compressor oil to keep your compressors running with free rings, clean valves, open air lines . . . with minimum wear and maintenance costs.

Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

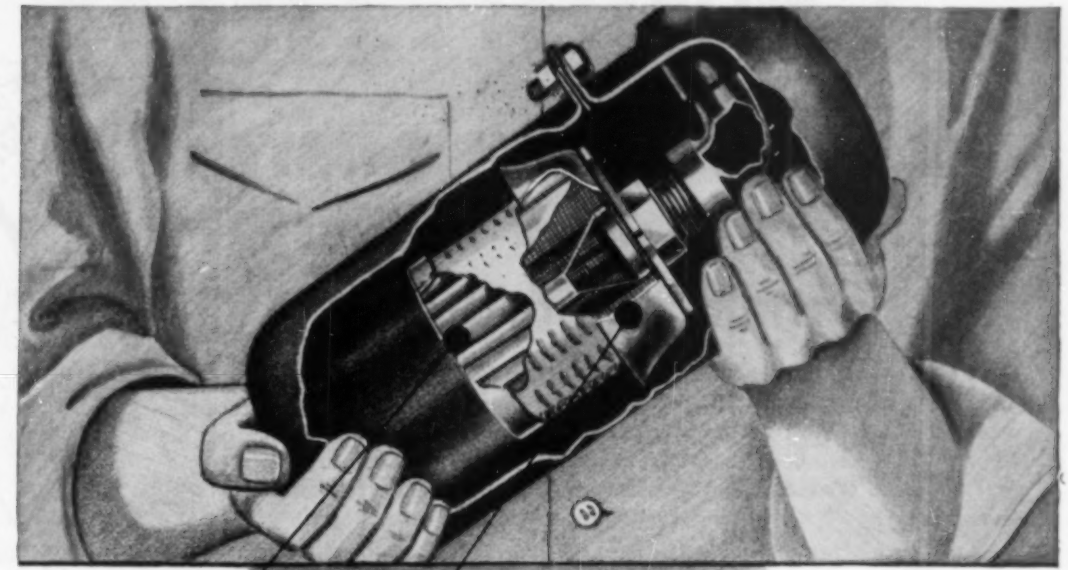
REG. T. M.

TEXACO Air Compressor Oils

FOR ALL OPERATING CONDITIONS

TUNE IN . . . TEXACO STAR THEATER starring MILTON BERLE on television every Tuesday night. See newspaper for time and station

STAYNEW PIPE LINE FILTERS



ELIMINATE
MOISTURE
OIL
DIRT
PIPE SCALE
from Compressed Air Lines

Tests prove that Staynew Filters often save their entire cost in just a few weeks. By preventing the passage of foreign matter, including moisture (water and oil), they prevent excess wear, costly freeze-ups, damage to materials and interference with processes.

EXCLUSIVE DOUBLE-ACTION PRINCIPLE PROVIDES:

- **MECHANICAL SEPARATION**—Deflector Cup drives foreign matter to bottom of container where heavier particles are deposited.
- **FILTRATION**—air or gas rises thru the original Radial Fin Insert which removes the lighter material.

DOLLINGER PROTECTOMOTOR STAYNEW FILTERS

IMPORTANT APPLICATIONS: Protection of Air-operated Tools and Controls • Paint Spraying • Sand Blasting • Air Displacement or Agitation of Liquids

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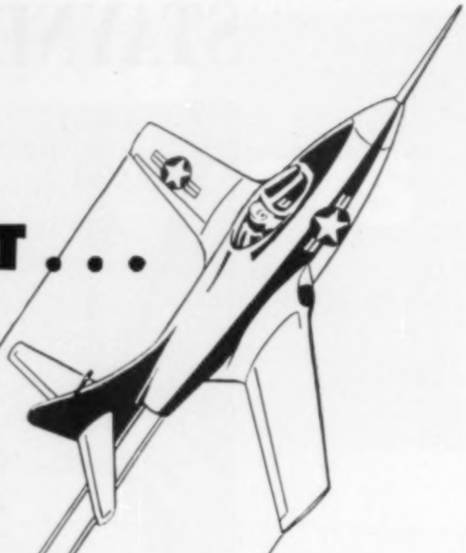
THE SKY'S THE LIMIT . . .

IN TIME- AND LABOR-SAVINGS

WITH IR AIR TOOLS



Built to top quality standards, reliable Ingersoll-Rand Air Tools are designed to meet your most rigid production requirements. Small and light enough to be used for assembly line service by either men or women, I-R Air Tools have been proven on tough jobs throughout industry for over 50 years. Contact your Ingersoll-Rand branch office for full information today!

DRILLS

Over twenty aircraft sizes for every material from aluminum to nickel alloy steel, for every speed from 550 to 15,000 rpm, for every capacity from 5/32" to ½".

IMPACTOOLS

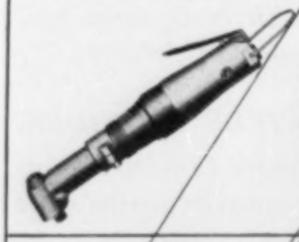
For speeding up nut running, with no kick or twist to the operator. Five aircraft sizes available in capacities from a #10 screw to ⅝" bolt size.

ANGLE DRILLS

Over thirty aircraft sizes to solve even your trickiest drilling problems. Six types of angle heads, speeds from 365 to 3000 rpm, capacities from 5/32" to ½"

GRINDERS

Three aircraft sizes for small mounted wheels, rotary files, and up to 2" diameter wheels. These tools are rigidly constructed for heavy duty operation, but are light-in-weight for precision work.

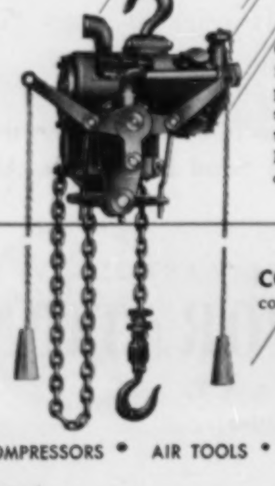


NUT RUNNERS

Over thirty aircraft sizes of Angle and Straight Nut Runners for precise torque control for jobs from a #10 screw to ½" bolt size.

SCREW DRIVERS

Thirty-eight aircraft sizes and two styles of handles for rapid screw driving to accurate torque requirements. Capacities from #8 to 5/16" diameter screws. Complete list of bits available.



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Over thirty-five sizes for loads from 200 to 20,000 lbs. Complete speed control from a smooth crawl to full speed. Two types available, overhead for lifting, and utility for hauling or hoisting.

RIVETERS

Specifically designed for aircraft riveting to meet high standards and tight production schedules. Six sizes to handle all your riveting jobs from 3/32" to ½" diameter rivets. Each size available with 3 styles of handles.

COMPRESSORS – A complete line of Air Compressors to handle your largest and smallest compressed air requirements.

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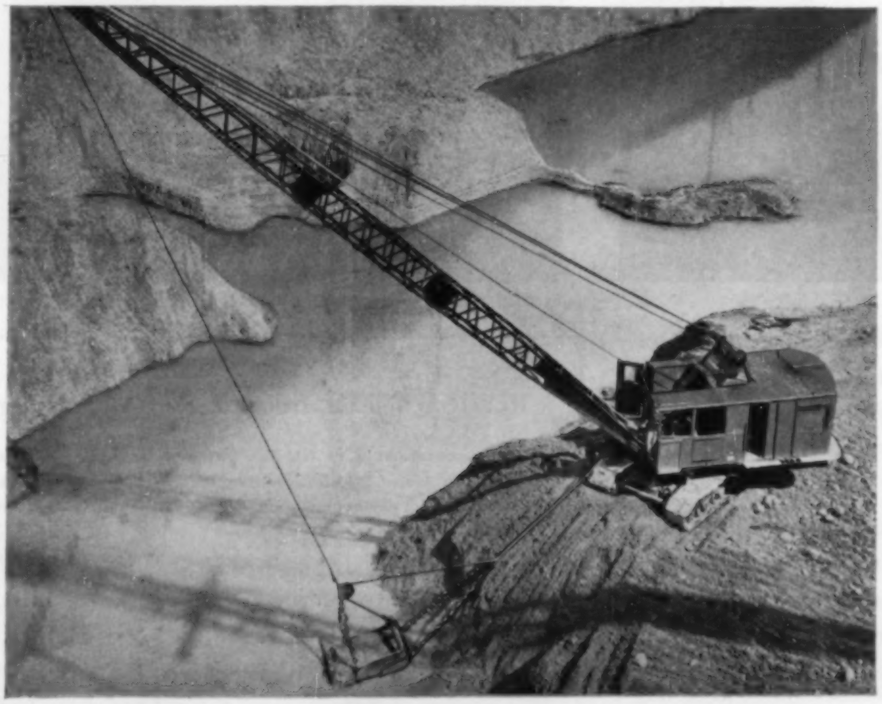
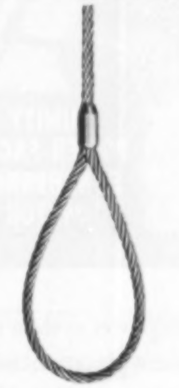
WIRE ROPE

You'll save time and cut costs with ROEBLING rope

FAST OPERATION AND DOLLAR SAVINGS are more important than ever in excavating and construction. One sure way to save time and expense is to specify Roebling Preformed "Blue Center" Steel Wire Rope. Here's a tough rope that stands up under shocks, strains and high speeds. Its preforming always assures maximum handling ease, better spooling and much smoother performance on the job.

Roebling makes a full line of wire rope. Have your Roebling Field Man recommend the *right* ropes for your equipment. And for longest life, get his advice on the correct use and maintenance of wire rope. It is based on experience with thousands of installations. John A. Roebling's Sons Company, Trenton 2, New Jersey.





ROEBLING ALL-PURPOSE SLINGS with the Tapered Sleeve Splice come to you ready for the job. They cost less than tucked splices . . . have the full strength of the rope. Send for the full story.

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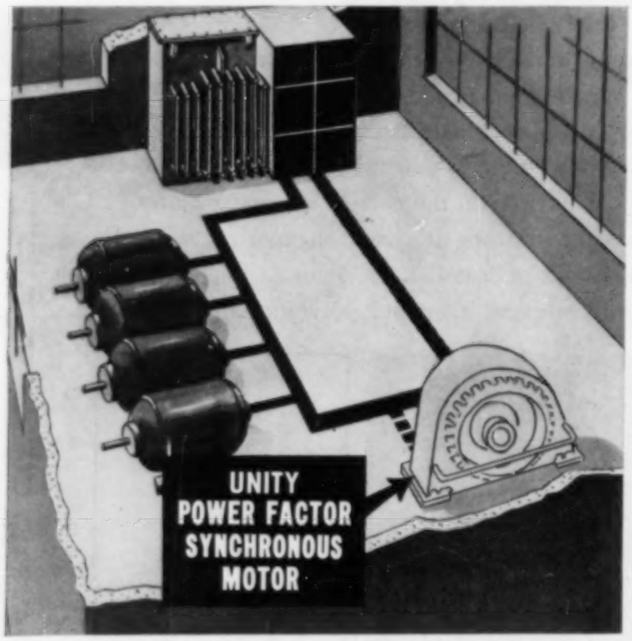
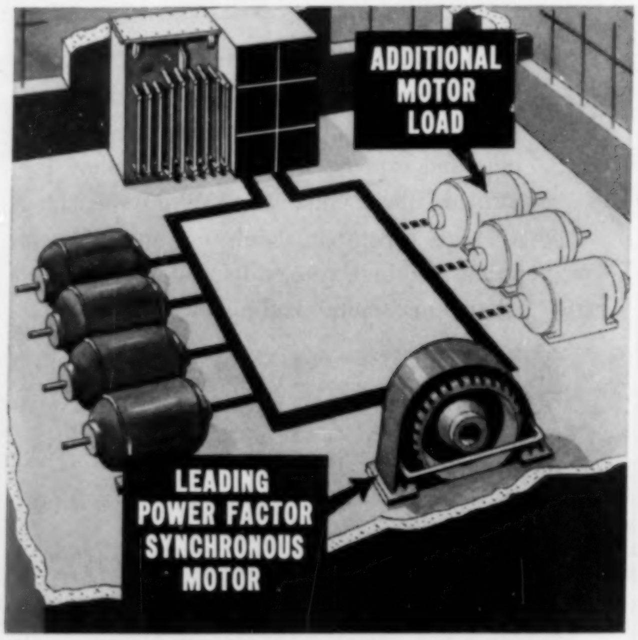
How to get more out

. . . . install G-E Synchronous Motors





If your plant power system is loaded close to full capacity and you have a place where a large constant-speed motor can be used, you may be able to install a *unity power-factor* synchronous motor without increasing the kva load on your system.

Or, if your power system is already overloaded, then a *leading power-factor* synchronous motor can actually supply kvars to your system while performing its usual drive duties. Then you can often install additional inductive apparatus to an existing system without fear of overloading feeder lines.

If you are planning plant expansion or you need more motors and/or suspect power system overloading, contact the nearest G-E sales engineer. He'll help you survey your system, and help you determine the type of synchronous motor you need—should this be one answer to your power system problems. *General Electric Company, Schenectady, N.Y.*

NEW! A Helpful Training Course on Motors!

Everyone concerned with technical training problems will want this new G-E Motor Selection and Application Course. Consists of 9 short, easily understood lessons. Complete kit—slide films, review booklets and instructor's manual—$100. Call or write your nearest G-E sales office, or send for free copy of 96-page instructor's manual.

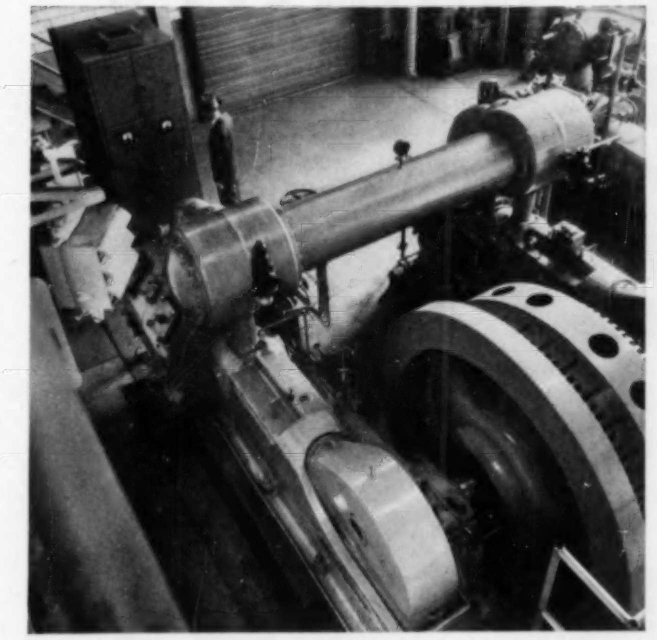
Look at the scope of this Course

1. **Fundamentals of Motors**
2. **Types of Motors**
3. **Fundamentals of Selection**
4. **A-c Induction Motors**
5. **Single-phase Motors**
6. **D-c Motors**
7. **Synchronous Motors**
8. **Adjustable-speed Drives**
9. **Gear Motors**

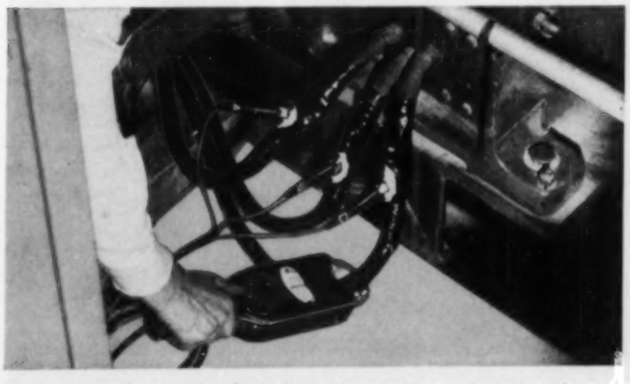
GENERAL ELECTRIC

# of your power system

for unity and leading power-factor drives



Control, too, will protect your system—G-E Limitamp high-voltage control provides ample interrupting capacity, protection for operating personnel, good appearance, and compactness. Here it controls and protects a 350-hp G-E synchronous motor.



Check power factor on individual circuits—**easily, quickly—with new G-E hook-on power-factor meter. This portable instrument hooks around the line—no cutting of conductors, no costly shutdowns to make power checks. You can accurately locate those circuits where corrective action is needed.**

G-E SYNCHRONOUS MOTORS ARE DRIVING . . . .

pumps
compressors
Jordans
beaters
crushers
ball mills
tube mills
large conveyors
blowers
saws
generators
rolling mills
pulp refiners
chippers
flour mills
stock refiners
line shafts
fans . . . .

in all types of industries where their efficiency, low first cost, and reliability make them exceedingly popular.

General Electric Co. Sect. N770-25
Schenectady 5, N. Y.

Please send me the following literature. . .

☐ for reference purposes
☐ for planning an immediate project

( ) GER-234—Synchronous Motors Do Two Jobs at One Time
( ) GEA-5332—Low-speed Synchronous Motors
( ) GEA-5426—High-speed Synchronous Motors
( ) GEA-5469—G-E Testing Instruments
( ) GEZ-310—Motor Training Course Instructor's Manual

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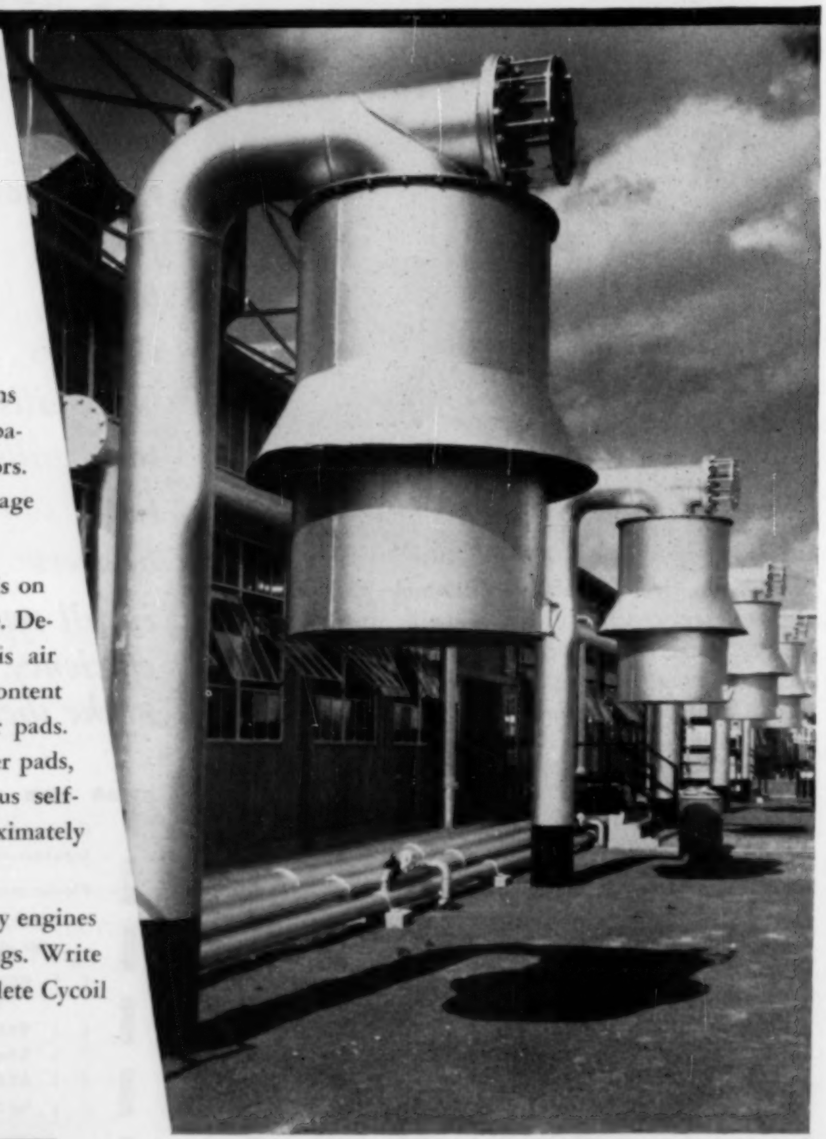
"DUST DOCTORS" to Industry



CYCOIL OIL BATH AIR CLEANERS GUARD HEALTH—PROLONG LIFE of ENGINES and COMPRESSORS

Dust damage, resulting in costly shutdowns and repairs, was once accepted as an occupational disease among engines and compressors. Today, "down time" traceable to such damage is an exception rather than the rule.

The reason—Cycoil, the "dust doctor," is on the job practicing true preventive medicine. Designed to operate at 100% efficiency, this air cleaner traps over 90% of the fine-dust content of the air before it even reaches the filter pads. Thus, with added filtration of the dual filter pads, plus positive oil circulation for continuous self-cleaning action, your final result is approximately 100% clean air.

Yes, Cycoil's high efficiency means healthy engines and compressors—along with healthy savings. Write for Bulletin No. 130. It gives you the complete Cycoil story right down to the last bolt and nut.

Today's Best Buy is Better Air!

AAF

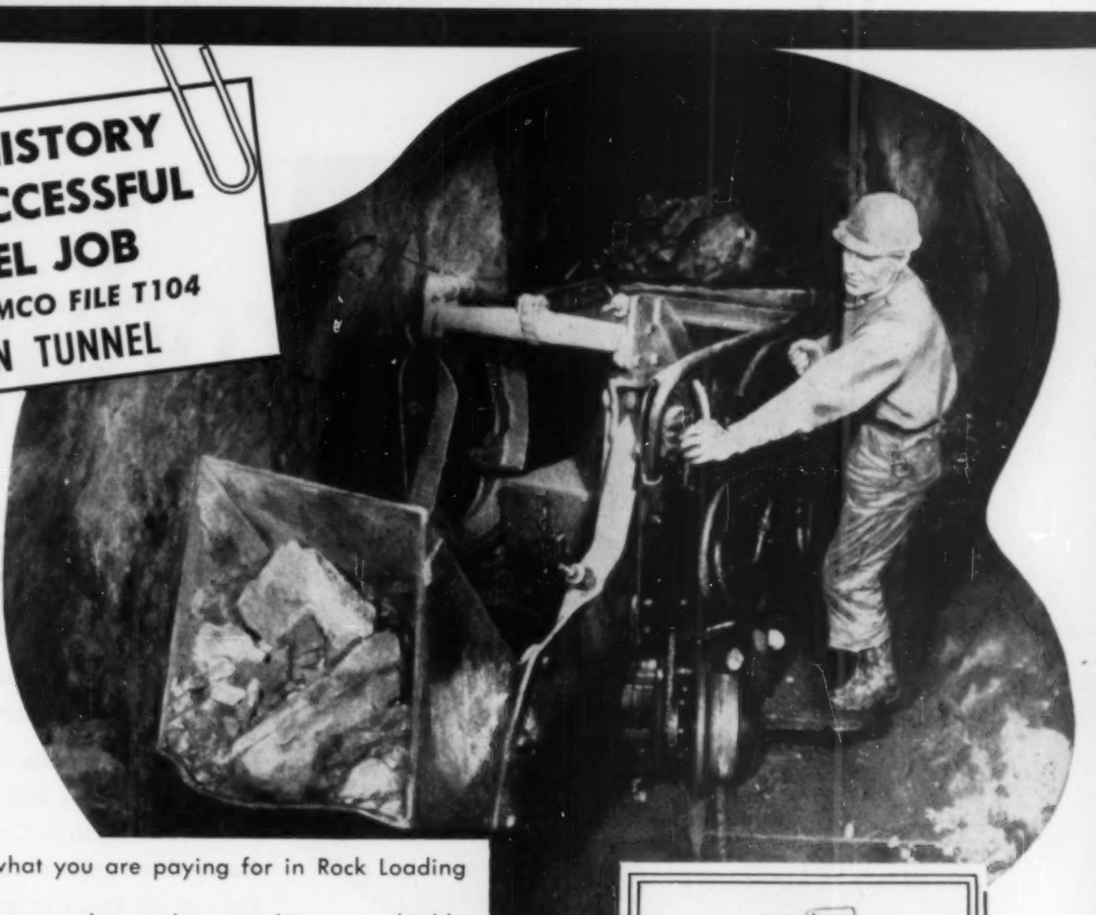
American Air Filter
COMPANY, INC.

402 Central Avenue, Louisville 8, Kentucky • Darling Brothers, Ltd., Montreal, P. Q.

CASE HISTORY OF A SUCCESSFUL TUNNEL JOB

FROM THE EIMCO FILE T104

CARLTON TUNNEL

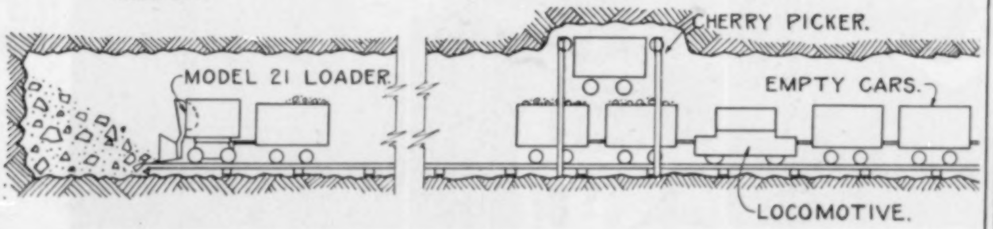


Are you getting what you are paying for in Rock Loading Equipment?

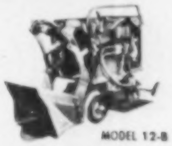
Eimco rock loaders are heavy-duty machines, so highly regarded by the users in the field that their price value on the second hand market is often the same as prices quoted for new machinery advertised as "the same as" or "as good as" Eimco's.

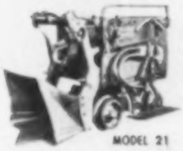
Only one important reason can be responsible for this leadership — that Eimco, as the only successful pioneer of this type of equipment, has retained its leadership by building quality machinery. Quality machinery means: heavier in construction, less maintenance, easier operation, more dependability, lower air consumption and all the other items you can think of when you consider a better grade of machinery over a cheaper article.

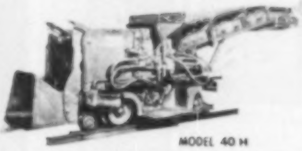
The Carlton Tunnel — driven to dewater the valuable mining claims in the Cripple Creek district of Colorado. Total length 32,267 feet. Tunnel size 10′ x 11′. Average depth round 7.14 feet. Rounds in good ground averaged 8′ and 9′ mucking time less than an hour. Best month 1870 feet, best day 78′, mucking machines—Eimco Model 21's.

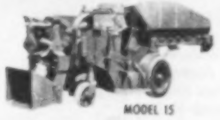


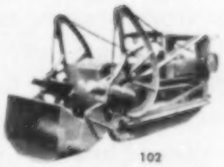
Carlton Tunnel used the "cherry-picker" method of car switching with the overhead lift equipped with an air cylinder. The cherry-picker was mounted on skids so that it could be moved forward, by the locomotive, as required.


MODEL 12-B


MODEL 21


MODEL 40 H


MODEL 15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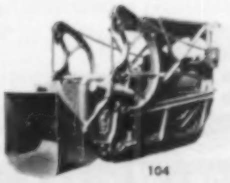
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EIMCO

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The World's Largest Manufacturers of Underground Rock Loading Machines

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CYLINDER POWER

increases production

UP TO 100%...

HANNA

AIR and HYDRAULIC

CYLINDERS

Use It 1001 Ways For Pushing, Pulling, Lifting, Pressing, Clamping, Controlling

INVESTIGATE Hanna Cylinder Power to speed production and lower costs. Hanna Air and Hydraulic Cylinders are used in hundreds of applications throughout industry—in all types of machines and equipment—to get things done faster, relieve tiresome manual operation, simplify actuation and control. Cylinder Power is easily adaptable, safe and inexpensive!

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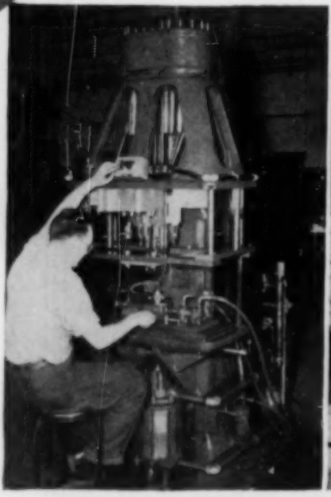
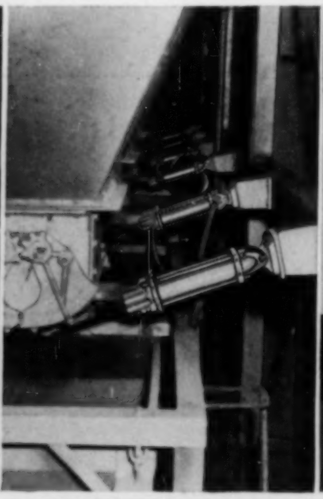
Send for Catalogs

Ask for Catalog No. 236 for Hanna Low Pressure Cylinders—Catalog 233A for Hanna Hydraulic Cylinders and Catalog 254 for Hanna Valves.



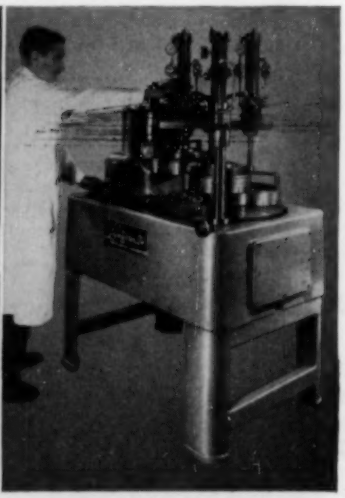
REDUCES FATIGUE

One pushbutton starts the Natco cycle for continuous, automatic operation of this drilling machine. Hanna Hydraulic Cylinders feed the table and Hanna Pneumatic Cylinders engage drillpress clutch and workpiece clamp.



REMOTE CONTROL

What could be more simple and dependable for opening and closing these hopper gates than Hanna Cylinders? They are operated from remote station with Solenoid Valves and Pushbutton Panel.



DOUBLES PRODUCTION

Hanna Air Cylinders raise and lower the entire conditioning ring-pressure plate units to permit fast, efficient loading and unloading of parts on this Lapmaster. In many cases, production has been doubled over manual operation.

Hanna Engineering Works

HYDRAULIC AND PNEUMATIC EQUIPMENT . . . CYLINDERS . . . VALVES . . . RIVETERS

1745 Elston Avenue, Chicago 22, Illinois

BUCYRUS-ERIE
EXTRA VALUES MEAN

Dependable High Output

Big, dependable yardages are "standard equipment" for Bucyrus-Erie excavators, as owners and operators the world over will testify. The superior performance records of Bucyrus-Erie result from fast, smooth operating cycles and on-the-job reliability for peak output every shift . . . *plus* the extra values of soundly engineered design and durable construction available only to Bucyrus-Erie as a result of its unmatched experience in the construction of quality excavating machinery.

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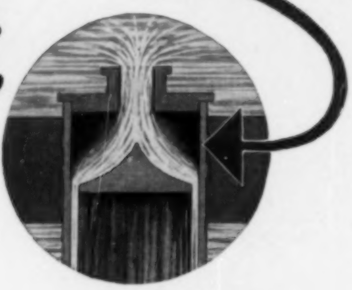
Dirty Water can't "Shut-down"... Vogt



film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441

TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler.*

BOTTOM: *Jacket Water Coolers serving engines of 7,300 HP in the compression plant of a Western Oil Refinery.*

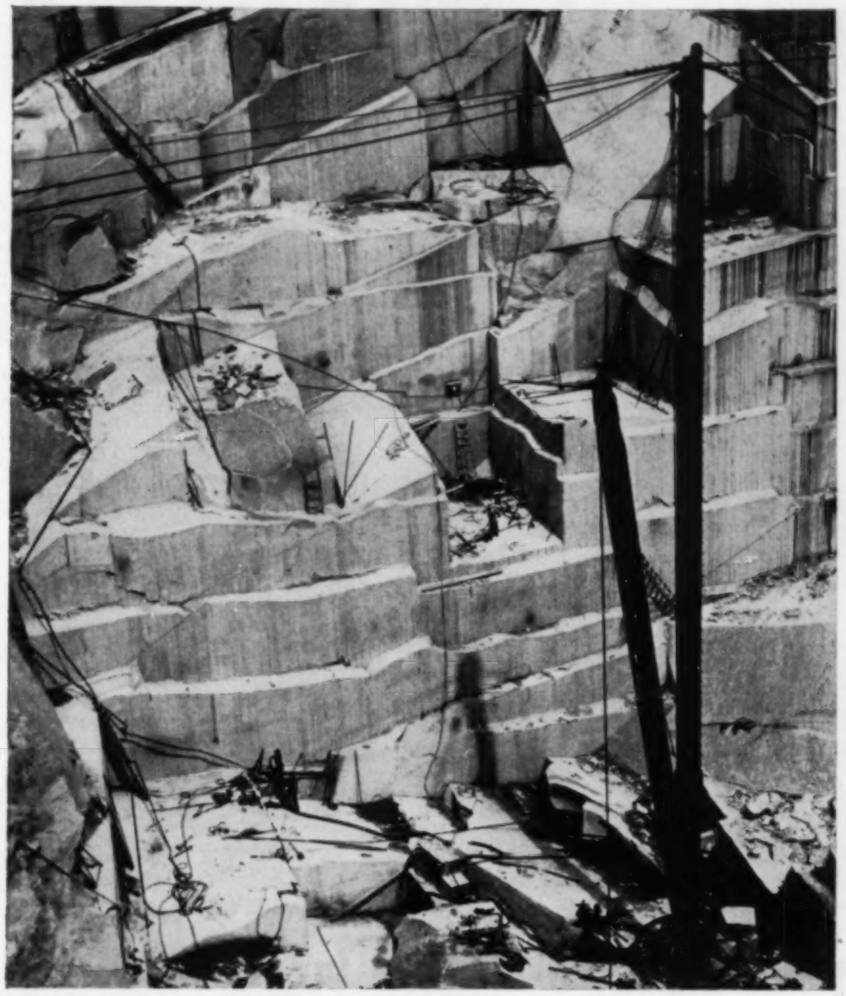
River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request.]

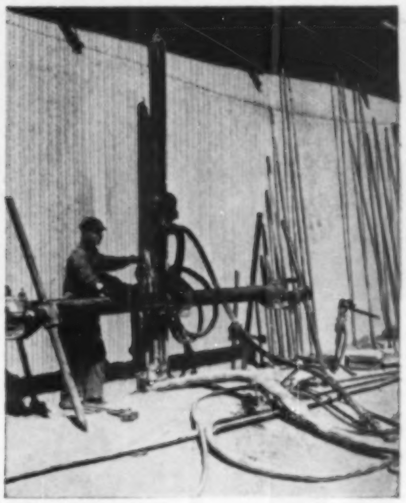
HENRY VOGT MACHINE CO., LOUISVILLE, KY.

Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA,
ST. LOUIS, CHARLESTON, W. VA.



The Rock of Ages quarry at Barre now has a depth equal to the height of a 27-story building. The area of the opening is about 40 acres. Largest source in the world for monumental granite, this famous operation was visited by 17,000 sightseers in 1950.

This quarry-bar mounting holds the rock drill on a movable saddle, permitting closely-spaced holes to be drilled in perfect alignment. Rods of **Bethlehem** Hollow Drill Steel at the right are fitted with detachable bits.



ROCK OF AGES from the rugged hills of Vermont

For more than a half century Rock of Ages granite has been a symbol of unyielding strength and everlasting beauty—a rock whose fine-grained texture is worthy of the highest skills in sculpture, architecture, and memorial carving.

Granite at its finest is found in the Rock of Ages quarry near Barre, Vermont. It occurs not in strata, but in the form of huge boulders — a geological formation that releases its treasure with great reluctance.

A dense, igneous material, Rock of Ages granite is a compact mixture of feldspar, biotite and quartz—the hardest of the constituents. Blasting is seldom used in quarrying because the beauty and texture of the premium granite would be marred.

Usually a line of closely-spaced holes is drilled in one direction; others are drilled at right angles to the first. Wedges are then driven into the holes to break the block loose. It all sounds very simple. But it sometimes requires as long as two months of patient drilling for two men to channel and break out a block 30 ft long, 30 ft wide and 15 ft high, weighing about 135 tons. And 80 per cent of all material hoisted from the quarry is unusable for memorial purposes.

The drilling of this hard, dense-grained rock calls for special equipment and good steel. Every bar of hollow drill steel used at this Rock of Ages quarry is exclusively Bethlehem. This fine steel gives dependable, economical service.

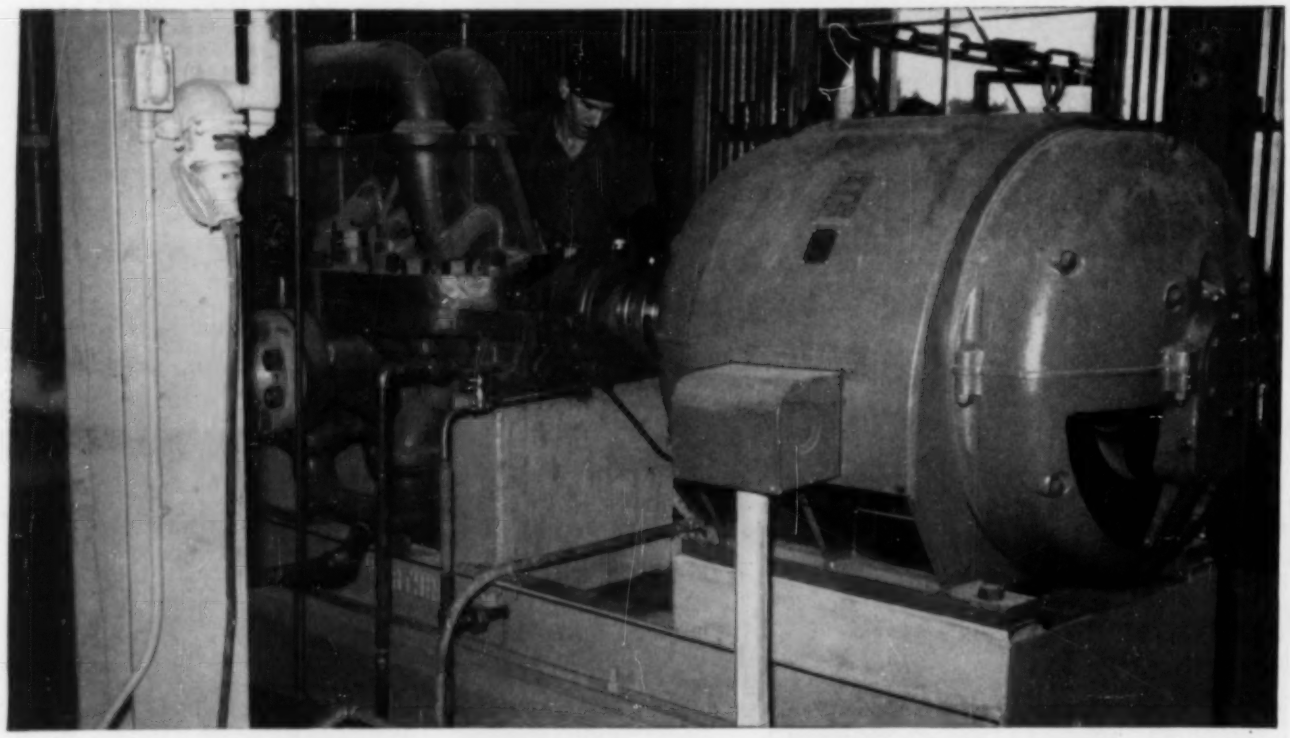
BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by
Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

★ BETHLEHEM STEEL ★

BETHLEHEM HOLLOW DRILL STEEL

35 Starts a Week!



Spaulding's E-M 2-Pole Induction Motor
WITHSTANDS SEVERE STARTING DUTY

J. B. Wilt, Manager of Spaulding Pulp and Paper Company of Newburg, Oregon, says: "We have found our 500 hp E-M Induction Motor equal to every demand placed upon it. It has been entirely satisfactory in performance and has handled capably the frequent starts to which it is normally subjected."

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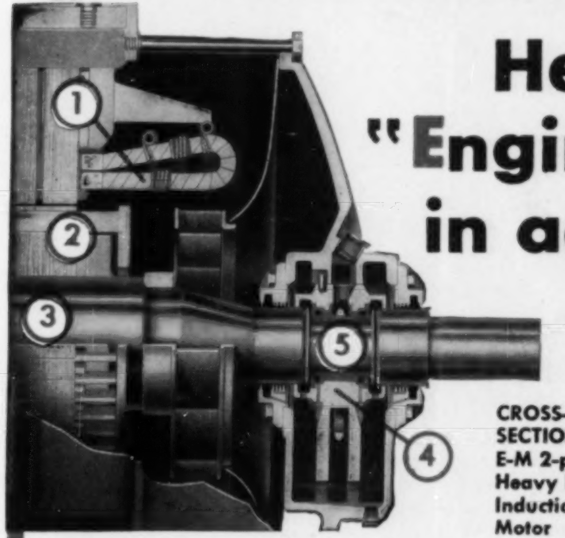
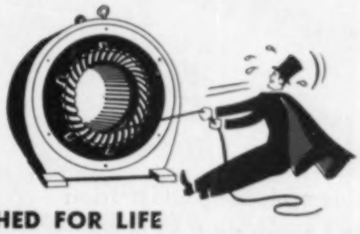


CROSS-SECTION of E-M 2-pole, Heavy Duty Induction Motor



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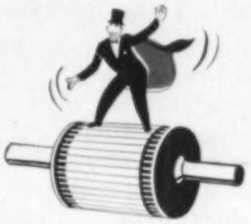

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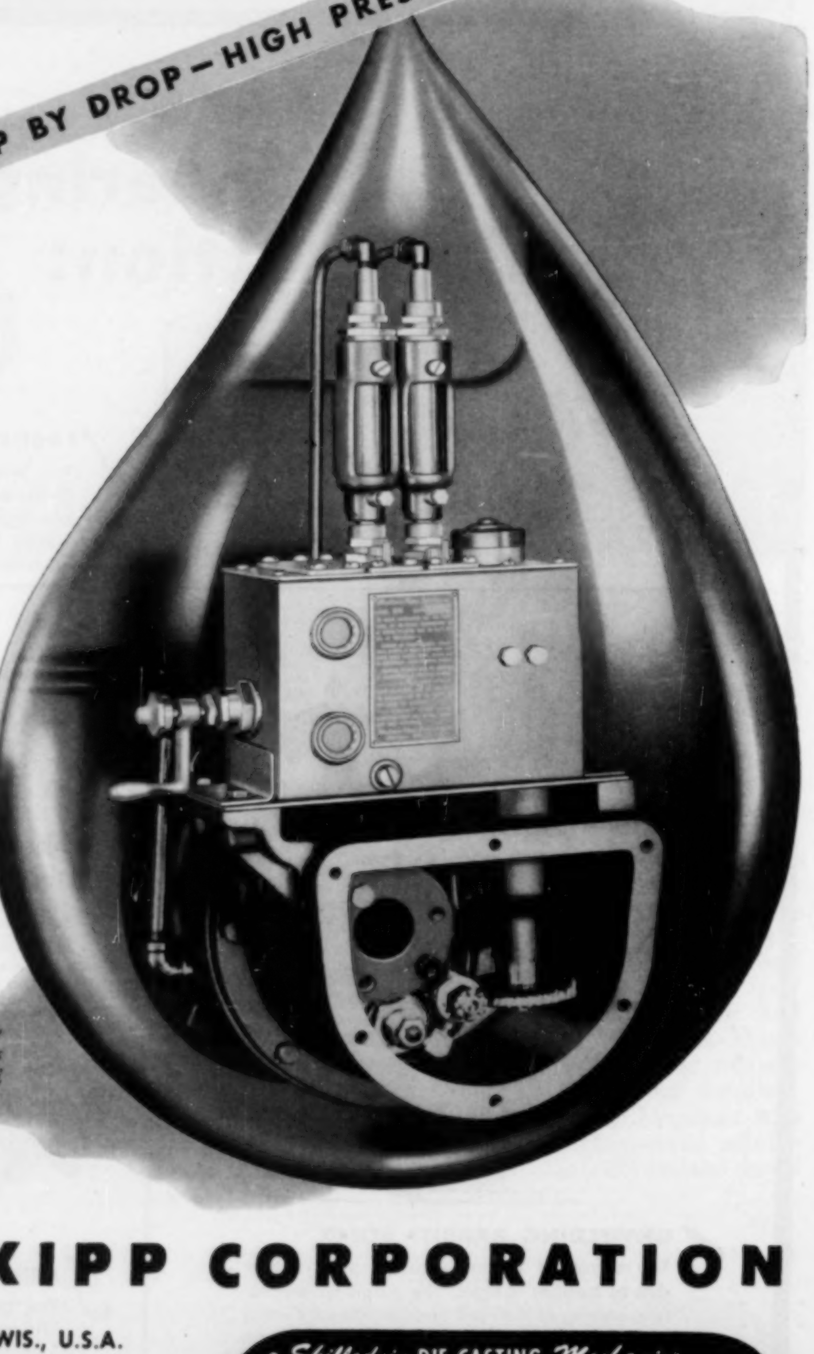

Madison-Kipp Bottom Rotary Drive Model SVH Lubricator as applied to Ingersoll-Rand XLE Compressor.

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ON THE COVER

ONE day in the spring of 1950 Paddy Martinez, who is part Navajo Indian and part Spanish, overheard two men on a street corner in Grants, N. Mex., discussing a piece of rock one of them was holding. Paddy gathered that it contained a mineral called uranium and that the Government wanted more of it badly. He decided to keep his eyes open for it while riding around on horseback among his sheep.

Not long afterward, near Haystack Mountain, Paddy spotted some yellowish rock that looked like the piece he had seen. He took a sample to his old friend Mayor Carroll Gunderson who runs a general store in Grants. Gunderson didn't know what it was and referred Paddy to some students from a mining school who happened to be in town. They said the rock was carnotite but that it was worthless.

The specimen came from land owned by the Santa Fe Railroad, and word of the find reached the road's mining engineer, Thomas O. Evans, in Los Angeles, Calif. He investigated and determined that the yellow mineral was tyuyamunite which contains calcium, uranium and vanadium and had been found in only a few other places. The pure mineral contains from 48 to 55 percent uranium oxide. The question was and still is, how much of it is there around? The Santa Fe has been carefully prospecting the area ever since last winter. Indications are favorable, but the value of Paddy's find has not yet been definitely determined.

•

IN THIS ISSUE

ALTHOUGH the uses of aluminum are legion, and every housewife is familiar with the metal, it is closely bound up right now with national security through its intensive application in military aircraft. Only a nation that has adequate resources for generating electricity can make aluminum economically or in large quantities. To extract a ton of metallic aluminum from alumina requires enough current to light the average dwelling for fifteen years. Our leading article gives the high lights of aluminum production.

•

IN HIS article on "Power from the Wind," (page 263) Dr. Penrose S. Albright gives convincing reasons why more advantage should be taken of the free winds that blow from every quarter. Windmills were first used as long ago as the twelfth century to grind grain, later to pump water, and now several countries are making serious efforts to develop wind turbines to conserve coal in the production of electricity.

•

URANIUM production in this country is now largely confined to a vast area in Colorado, Utah, Arizona and New Mexico called the Colorado Plateau, but recent new finds in and around Grants, N. Mex., promise measurably to increase the output. Prospectors and geologists are keeping up an unceasing search for the raw material from which to extract the uranium isotopes for our advancing atomic-energy program. Page 267.

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IRON ore was discovered on the Menominee Range of Michigan a hundred years ago and was observed locally by a colorful celebration. See page 272.

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Aluminum — a Metallurgical Marvel

Finding of Economical Reduction Process Brought Once Costly Metal into Widespread Use

J. C. Pierce

ALUMINUM AND GLASS

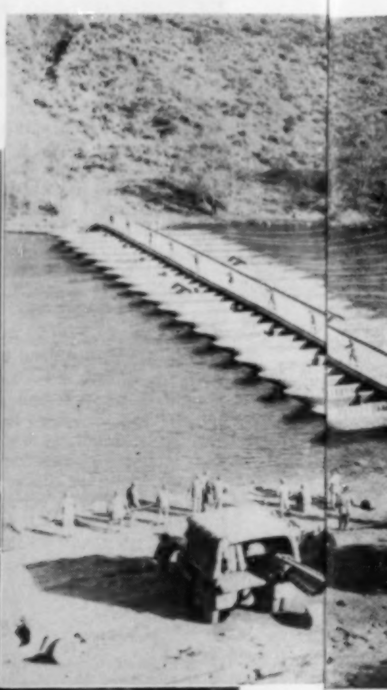
The east and west walls of the new 39-story United Nations Secretariat Building in New York City are virtually transparent. They are, in effect, two large windows each set in an aluminum framework. Rising 544 feet on the edge of the East River, the structure will accommodate 3000 UN officials and their staffs and has room for expansion so as to accommodate 4000. There are 2700 greenish-blue glass spandrels in a network of narrow-faced aluminum framing members on each of the 287-foot-wide sides. The other two walls are windowless and faced with gray Vermont marble.

PHOTOS, THE ALUMINUM ASSOCIATION

ALUMINUM APPAREL

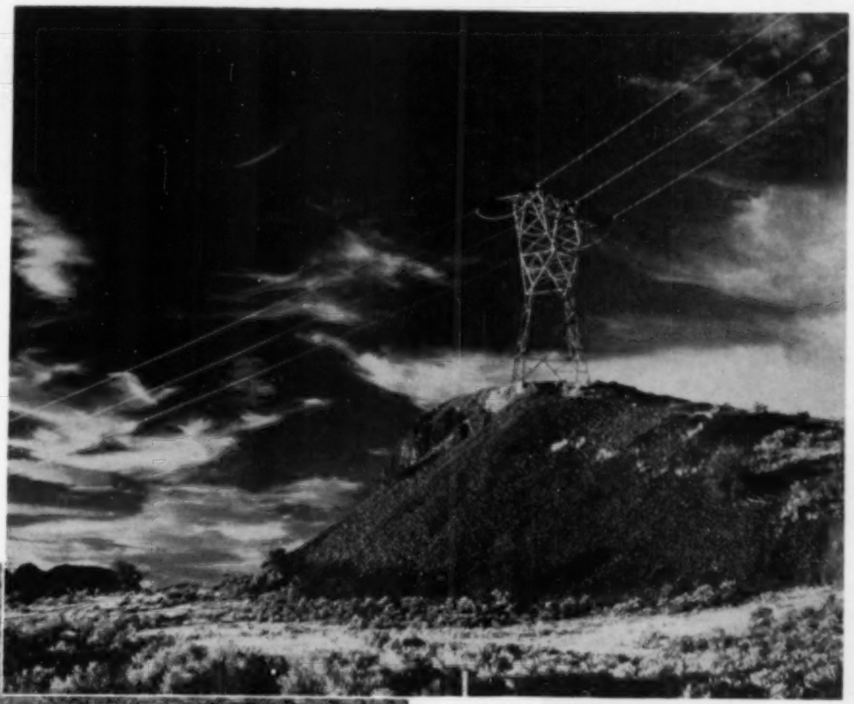
The lining of the coat the young lady is displaying is made of Milium one side of which has been sprayed with fine particles of aluminum which act as tiny mirrors to reflect back much of the body's radiated heat. Tests have shown that a thin fabric so coated will be as warm as a blanket ten times as thick. Only rayon satins, twills and crepes are now being treated in this manner, but it is known that the process can be used on wool, cotton, nylon and orlon. Consumers may soon see a great deal of these materials in clothing, draperies and bedding. Another feature of Milium-lined garments is that they reflect the sun's heat outward, making the fabric suitable for summer clothes.

●



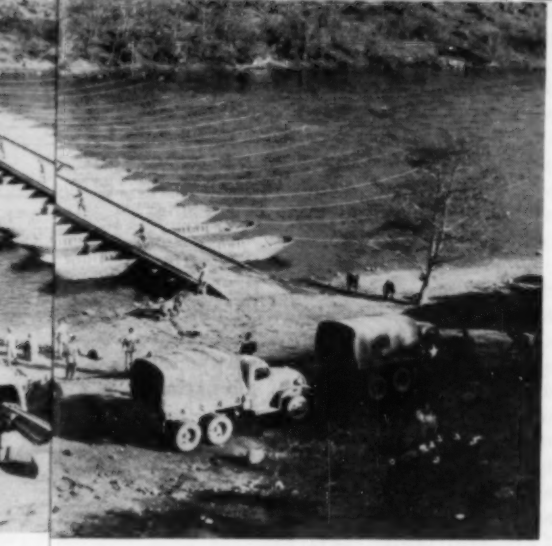
RUGGED APPLICATION

To lighten them for easier handling, some parts of rock drills and accessory equipment are now made of aluminum or its alloys. The Ingersoll-Rand machine shown at the right rides on an aluminum shell, and the same material is used for the safety clamp, cone clamp and the piston of the pneumatic column on which the drill is mounted.



TRANSMISSION LINE

The cables of this Bonneville-Grand Coulee transmission line of the Bonneville Power Administration are composed of steel-reinforced aluminum. Aluminum cables have been used since 1897 for carrying electricity, and the practice of giving them a steel core began in 1909. More than two million miles of such lines, in a wide range of sizes, now span the country.



QUICK BRIDGE JOB

The U. S. Army Corps of Engineers can put together a bridge like the one shown above in short order. The pontons are of aluminum and the deck is assembled of specially constructed aluminum-alloy members. The carrying capacity of the span is 60 tons.

MOST abundant of all the metallic elements in the Earth's crust and never found in the native state, aluminum is one of the metals that are highly resistant to separation from nature's compounds and has for centuries posed an aggravating problem. Not until 1825 was it isolated in the laboratory of the Danish scientist Hans Oersted, and twenty years elapsed before a few milligrams were recovered through a different method by Germany's Frederick Wohler. The latter was able to tell the world that aluminum is a shining, lightweight, malleable metal.

A few years later Henri Sainte-Claire Deville, a French chemist, improved upon Wohler's technique and showed a bar of aluminum at the Paris Exposition of 1855. With funds provided by Emperor Napoleon III, who wanted lighter equipment to increase the mobility of his army, Deville continued his experiments and in 1859 produced 2 tons of the prized metal—not enough to help Napoleon but sufficient for widespread research. The price per pound dropped to $17 with Deville's "commercial" development—a remarkable drop from the 1852 quotation of $545.

With that global introduction and promotion, scientists everywhere accepted the challenge to find a satisfactory large-scale process for the recovery of illusive aluminum from its associate elements. Failure became the rule of the laboratories, and years slipped by with only the eliminated avenues of approach chalked up as "progress" in the quest. Then the answer came. In 1886 the present method of obtaining the metal by electrolysis from a solution of alumina in molten cryolite was worked out simultaneously and independently by two 22-year-old men on opposite sides of the Atlantic Ocean—Charles Martin Hall in America and Paul L.T. Heroult in France. Pittsburgh financiers came to Hall's aid and organized the Pittsburgh Reduction Company, which began making aluminum on Thanksgiving Day, 1888. That firm later became the Aluminum Company of America. Heroult obtained financial backing from a group of Swiss businessmen who formed the Aluminum Industrie Aktiengesellschaft.

A production of 1400 million pounds annually while still in the test-tube stage—that's the story of aluminum in America. Fields of application of this metal are steadily increasing, and military and industrial expansion keep the current demand active. Research engineers are busy devising new uses, and metallurgists are continually being called upon to turn out new aluminum alloys to meet stringent specifications. Physicists and chemists have never relaxed in their search for a less expensive means of recovering the element from nature's tightly bound chemical combinations. Although the rapid growth of the industry has made the metal a part of all our lives, aluminum is still an infant servant of mankind.

While the United States had kept pace with aluminum requirements in the matter of facilities for the extraction of the mineral from ore, the situation as to the expansion of the industry is tight. Domestic reserves of the principal ore—bauxite—are limited, and foreign sources are being drawn upon extensively so as to conserve our supply. Prospectors are active in the search for bauxite, and efforts are being redoubled to develop an economically feasible process for the recovery of aluminum from low-grade bauxites and from other minerals such as clays containing appreciable quantities of aluminum. Too, additional domestic blocks of cheap electric current essential to its reduction must be made available, and steps are being taken to overcome this stalemate.

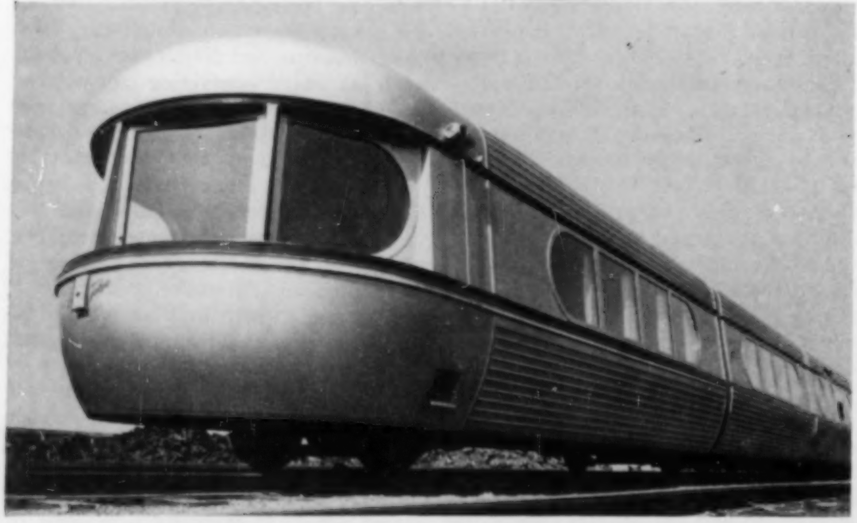
Bauxite derived its name from the village of Les Baux, France, where a French chemist, Berthier, discovered a high-alumina earth in 1821. The designation is now broadly applied to several different though similar minerals such as boehmite, gibbsite and hydrargillite. All are hydrates of alumina with varying proportions of water to alumina in the compound. Found in many parts of the world, it is generally confined to torrid damp areas—is typically a mineral of tropical and subtropical regions. It is the product of ages of leaching under hot, wet conditions from prehistoric rocks high in silica and alumina and ranges widely in color from pure white where no iron is present to dark red where the iron-oxide content is high.

Europe gets her bauxite from France, Hungary, Italy, Yugoslavia and Greece. It is found in Spain, Romania and Russia and produced in China, India, Malaya, the Netherlands Indies, and Australia. In Africa there are deposits in Nyasaland, the Gold Coast, French Guinea and Mozambique. We are interested in supplies from British Guiana, Surinam and Brazil in South America, and of most recent recognition are the West Indies deposits in Jamaica, Haiti and the Dominican Republic. The most important of our domestic reserves lie in Arkansas, and lesser amounts are scattered throughout Alabama, Georgia, Mississippi, Tennessee and Virginia.

Present production of bauxite in the United States is taking care of less than 40 percent of our requirements. Shipments from Indonesia to our shores have been maintained at a moderate rate; the African Gold Coast, British Guiana, and Brazil are potential suppliers; while Surinam is providing us with about 75 percent of our imports. But the brightest spot on the aluminum-ore horizon so far as we are concerned is Jamaica. That island, with an area of 4193 square miles just south of Cuba, is blessed with extensive deposits. To our gulf ports it is 2500 miles from Surinam, as against only 1000 miles from Jamaica. This shorter haul, besides the saving in cost, offers a definite advantage in case of war because the danger of attack by enemy submarines is proportionately reduced. The significance of this is brought home to us by the fact that more than 100 bauxite ships, exclusive of convoys, were destroyed by underwater boats in the Caribbean during 1942-43.

Jamaica ore is superior to ours in that it has a higher alumina content, is lower in silica, and contains a negligible percentage of iron (iron is the second common bauxite impurity, silica the first). Officials of Reynolds Jamaica Mines, Ltd., a subsidiary of Reynolds Metals Company, stress the importance of the Jamaica ore because it will enable them to extend the life of the Arkansas deposits and the organization's large Hurricane Creek plant located in that state. By mixing the ore from the two sources it will be possible to use the low-grade Arkansas ore that could otherwise not be treated by existing processes.

All four of the principal North American producers of aluminum are vitally interested in the West Indies ore, of which there is an estimated aggregate reserve covering all grades of 350 million tons (about 90 percent in Jamaica) or, roughly, seven times as much as all



BY LAND, WATER AND AIR

Aluminum is stealing the transportation show. The train pictured, is American Car & Foundry Company's new experimental unit "Talgo" in which aluminum is chiefly responsible for a reduction in weight of 75 percent, as compared with a steel train of the same capacity. A "coach" is composed of four passenger units and one equipment unit containing brake and air-conditioning apparatus, control lockers, washrooms and a kitchenette. The "Pvt. Joseph F. Merrell", top, is one of three new 290-foot ferry boats plying between Manhattan and Staten Island in New York Harbor and is capable of carrying 3000 passengers and 45 vehicles. Most of its 200,000 pounds of aluminum is in the superstructure. Military aircraft take the lion's share of our production of aluminum metal. A Martin XB-51 ground-support bomber is pictured in the center taking to the air. It is propelled by three powerful jet engines.

our known domestic deposits. Only Jamaica Bauxites, Ltd., a subsidiary of Canada's Aluminum, Ltd., and Reynolds Jamaica Mines are striving towards early production. The Reynolds development is the larger, with a planned expenditure of $14,500,000. Both are partially financed with ECA funds repayable in aluminum metal to the United States stockpile. The other producers are the well-established Aluminum Company of America and the Kaiser Aluminum & Chemical Corporation.

Bauxite is normally found in the earth's crust in beds or pods of irregular dimensions. Much of it is at or near the surface so that open-pit mining methods can be employed. As surface ore has been exhausted, deeper deposits have been sought and underground mining resorted to. In recent years about one-fourth of the domestic ore has come from below ground. Normal practices are generally followed in exploring for and delimiting ore bodies, as well as in both open-pit and underground mining operations. However, the physical characteristics of bauxite differ so much from bed to bed that little standardization has been possible with respect to underground work. The texture of the mineral varies considerably. It may be hard and dense, porous and spongy, or pebbly, soft and chalky, even plastic. A modified room-and-pillar system is favored for most operations below ground, though irregularities near the extremities of deposits may lead to the use of diverse mining methods and the display of a good deal of ingenuity to obtain maximum extraction.

The principal difficulties encountered in underground mining are usually attributable to the characteristically unstable roof and floor which are normally of clays and sands that must be kept out of the ore at all cost. Cave-ins and "squeezes" are always imminent and must be guarded against. Roofs often will not stand unsupported in large openings, and supports are both expensive and hard to install effectively. Hence, small headings that discourage broad mechanization are generally found. While drilled and blasted ore has been commonly mucked by hand, mechanical loaders have been successfully applied in some instances.

Variations in the ore's physical properties give rise to problems in preparing it for market. The choice of crushing and screening equipment largely depends upon its peculiarities in the matter of texture. The modern mill must contain machinery to wash excess silica from the raw materials. Where the iron content is appreciable, magnetic or electrostatic separators are employed to get rid of that impurity. Manufacturers of abrasives want the chemically combined water removed from their bauxite, and that calls for calcining. All products of the mill are dried before shipment.

The aluminum market takes the lion's share of the bauxite (about 85 percent in this country). Next in the order of consumption are: abrasives with synthetic corundum obtained by fusing bauxite, chemical salts such as aluminum sulphate, aluminum chloride, aluminum fluoride and sodium aluminate; and high-temperature and acid-resistant calcium-aluminate cement. It is also used in the oil industry as an adsorption medium in oil purification; in the making of high-alumina refractory materials; and as a low-density insulating material.

Direct extraction of pure aluminum metal from even the best grade of bauxite is not possible. First the bauxite (aluminum hydrate with impurities) has to be converted into alumina (aluminum oxide, Al_2O_3) from which the metal can be recovered electrolytically. There has been no better process devised for getting the impurities out of bauxite than that invented by Karl Josef Bayer, which was patented in Germany in 1888 and in the United States in 1894.

Modifications and improvements have been made since the first Bayer plant was built at Woburn, Mass., in 1894, but basically the treatment remains the same. The bauxite is reduced to powder by grinding, mixed with a hot solution of sodium hydroxide (caustic soda), and pumped to pressure digesters where the aluminum hydroxide is dissolved to form a sodium-aluminate solution. The impurities in the bauxite remain in a solid state and are removed by filtration. The solution is then transferred to large tanks where slow cooling results in the precipitation of the aluminum hydroxide. After it has been washed free of the caustic soda and been calcined it is alumina.

It takes from 4 to 6 pounds of bauxite ore and 10 kw-hrs of electricity to produce a pound of aluminum metal. The high rate of consumption of electrical energy is the real bottleneck in the industry. The Hall-Heroult process, the key to the world's commercial aluminum, is an electricity "hog." This means that it is an expensive one unless tied to a source of cheap power—unless reduction plants are situated near large hydroelectric stations. An exception is the new Aluminum Company of America plant at Point Comfort, Tex., where direct current is generated by internal-combustion engines fired with natural gas from nearby fields. Another one shortly to be built by the same concern near Waco, Tex., is to use electricity generated by a steam plant burning lignite (sub-bituminous coal) from a large deposit.

By improving techniques and processes, by expanding production to the point where the unit cost is low, and by locating reduction works near sources of cheap electric power the cost of aluminum metal to the consumer has been cut to its present level of nineteen cents

PNEUMATIC RIVETING

Sewing the aluminum skin on aircraft might appear to be a tedious job, but the Ingersoll-Rand riveting hammer shown here makes it a speedy operation with a minimum of effort on the part of the workers. Parts of many pneumatic tools are of aluminum to keep them light and readily maneuverable.

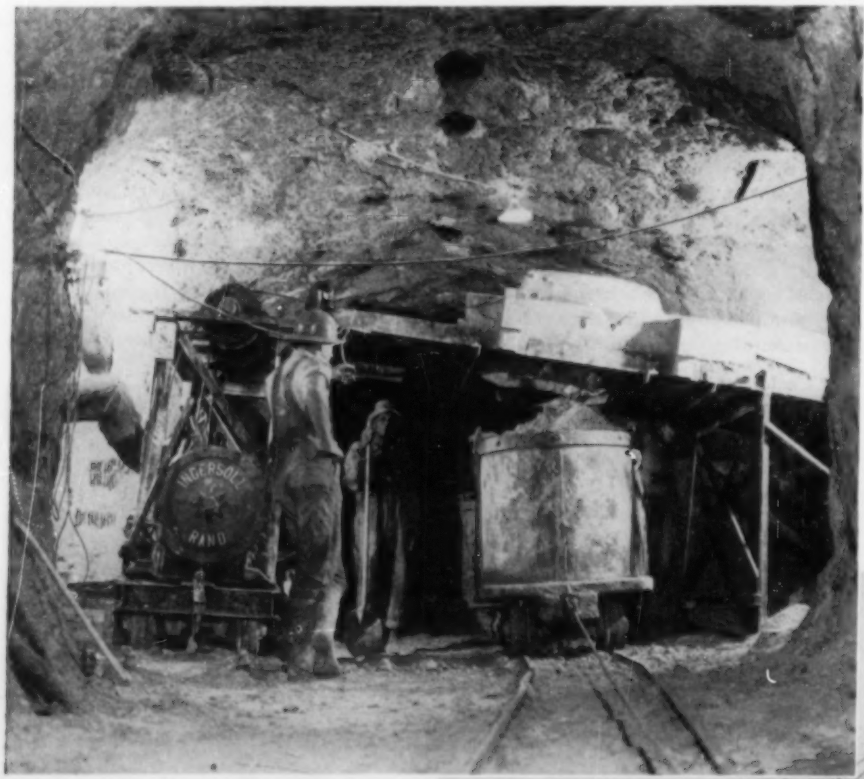
a pound. But hydroelectric plants in this country are overloaded, and the growing aluminum industry must look to new stations unless science finds a satisfactory substitute for the Hall-Heroult process. Only in an emergency, when the cost of aluminum is no object, can this country utilize the reduction capacity it built up during World War II. War-born plants maintained as stand-bys have a total annual capacity of 325 million pounds. Others have been sold with the proviso that metal be available for military purposes within a year after purchase.

Power-development prospectors have their eyes on Alaska; and Canada, which is now supplying us with about 20 percent of our primary aluminum, may take advantage of more of her huge potential water-power resources. Experiments with cheap and abundant fuels for generating electricity may soon prove successful. So now we see a race to harness inexpensive electric current to treat West Indies ore shipments that are expected to be large enough to keep the aluminum supply ahead of the demand.

The reduction of aluminum from aluminum oxide is not a complicated process and remains essentially the same as when devised in 1886. The electrolytic cell in which the aluminum is liberated from the oxygen in the compound has a carbon anode and a carbon cathode, the latter forming the lining of the cell. Cryolite is admitted and fused by an electric current before the alumina is introduced. As the current passes through the bath, decomposition of the alumina takes place. The aluminum metal settles on the bottom and is tapped off to form pigs, while the oxygen combines with the carbon of the anode to bubble through the crust of the melt and escape. It is a continuous cycle, with intermittent additions of alumina and tapping. About ¾ pound of carbon electrode is consumed for every pound of metal obtained. A remelt is required to remove dross and bath material that pours out with the metal, and alloying can be accomplished at this point. The principal alloying elements are copper, silicon, magnesium, manganese, zinc, nickel, iron and chromium.

In addition to the recovery of metal from bauxite there is another important source—scrap. This secondary production is no small industry in itself. There are two kinds of scrap: primary aluminum—such as clippings, grindings, borings, sheet trimmings, foil, wire, cable, rejected forgings, extrusions and castings—which generally goes back into the primary aluminum circuits except for some that serves to augment old scrap in alloying melts. The second kind represents discarded articles and may be as large in volume as primary scrap. Some 50 smelters throughout the United States purchase this material to produce casting alloys for sale to more than 3000 independent foundries and die casters. The yield of scrap in 1950 has been estimated at 500 million pounds.

One has only to look around to see expressed the adaptability and usefulness of aluminum and its alloys. It can be rolled into foil one-tenth the thickness of a sheet of newspaper, or cast into huge shapes. It can be drawn, extruded, stamped, spun, forged, machined, welded and riveted. In addition to remarkable workability and lightweight (specific gravity 2.70), it features high electrical and thermal conductiv-

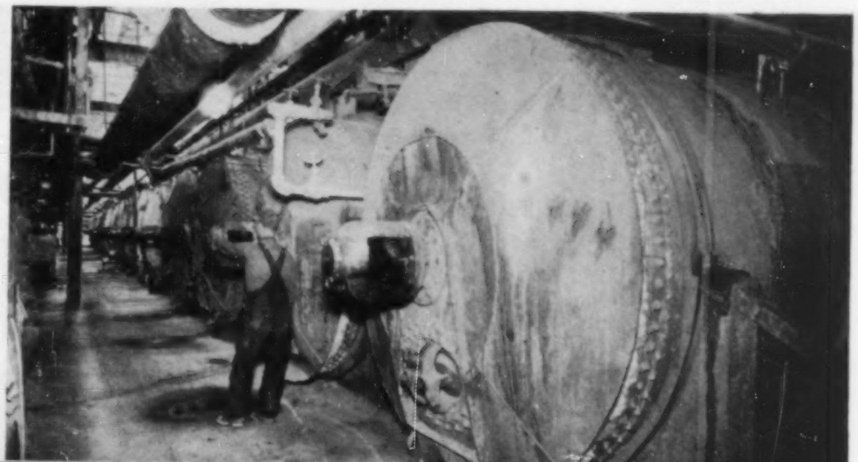


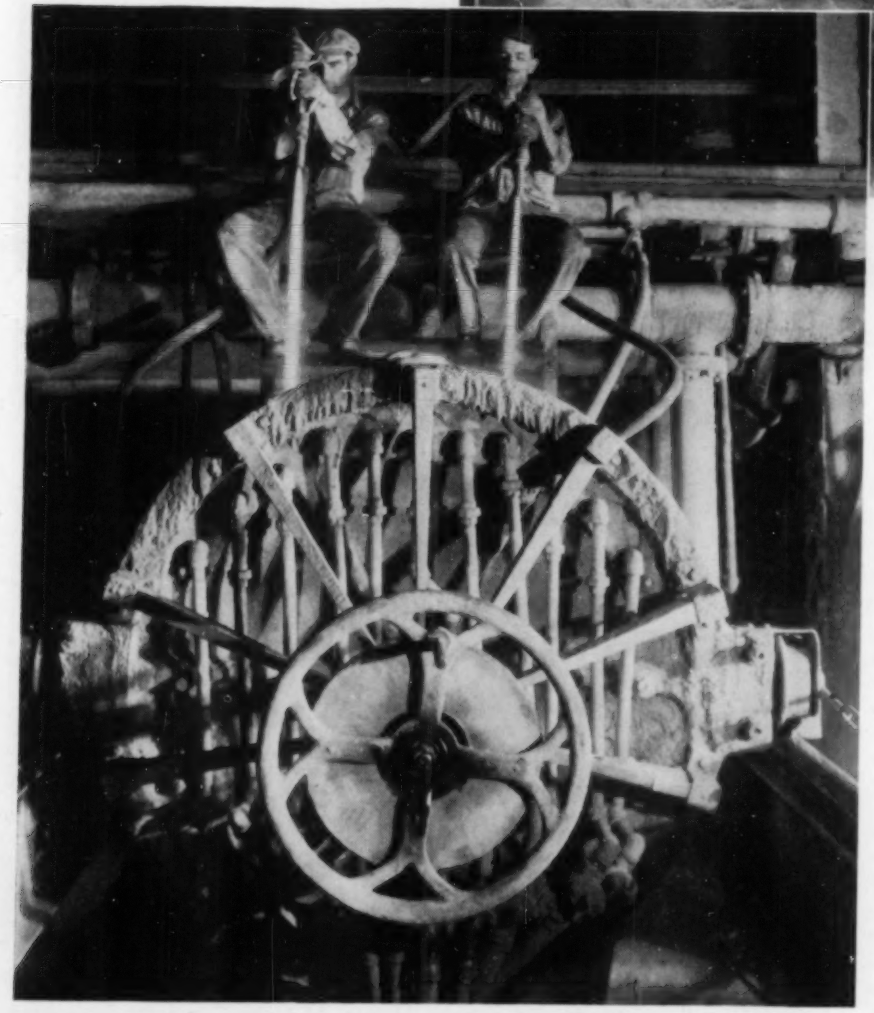
MINING BAUXITE

Most bauxite, principal ore of aluminum, is fortunately found at or near the surface so that high-tonnage, low-unit-cost open-pit mining methods can be used. The view at the right shows a Bucyrus-Erie shovel loading ore from such a working into a Euclid truck. Most domestic bauxite is mined in Arkansas, where several deposits are at depths that preclude open-pit operations. ¶ One economical and efficient way of loading ore underground is by a slusher or scraper-hoist arrangement like that pictured above. The slusher is powered by an Ingersoll-Rand 3-drum hoist.

ALUMINA FROM BAUXITE

The horizontal cylinders, right, are digesters in an alumina plant where finely ground bauxite ore is mixed with a hot solution of caustic soda under pressure. The caustic soda combines with the aluminum hydroxide to form sodium aluminate, which is then separated from the impurities in the ore in filter presses such as the one shown below, which is being cleaned. The sodium aluminate passes through the filter and on to precipitation tanks, while the undissolved waste components of the ore are scraped from the face of the filter for disposal.





ity, good light and heat reflectivity, and resistance to corrosion. Commercial aluminum has a tensile strength of 13,000 psi, and some alloys test as high as 80,000 psi.

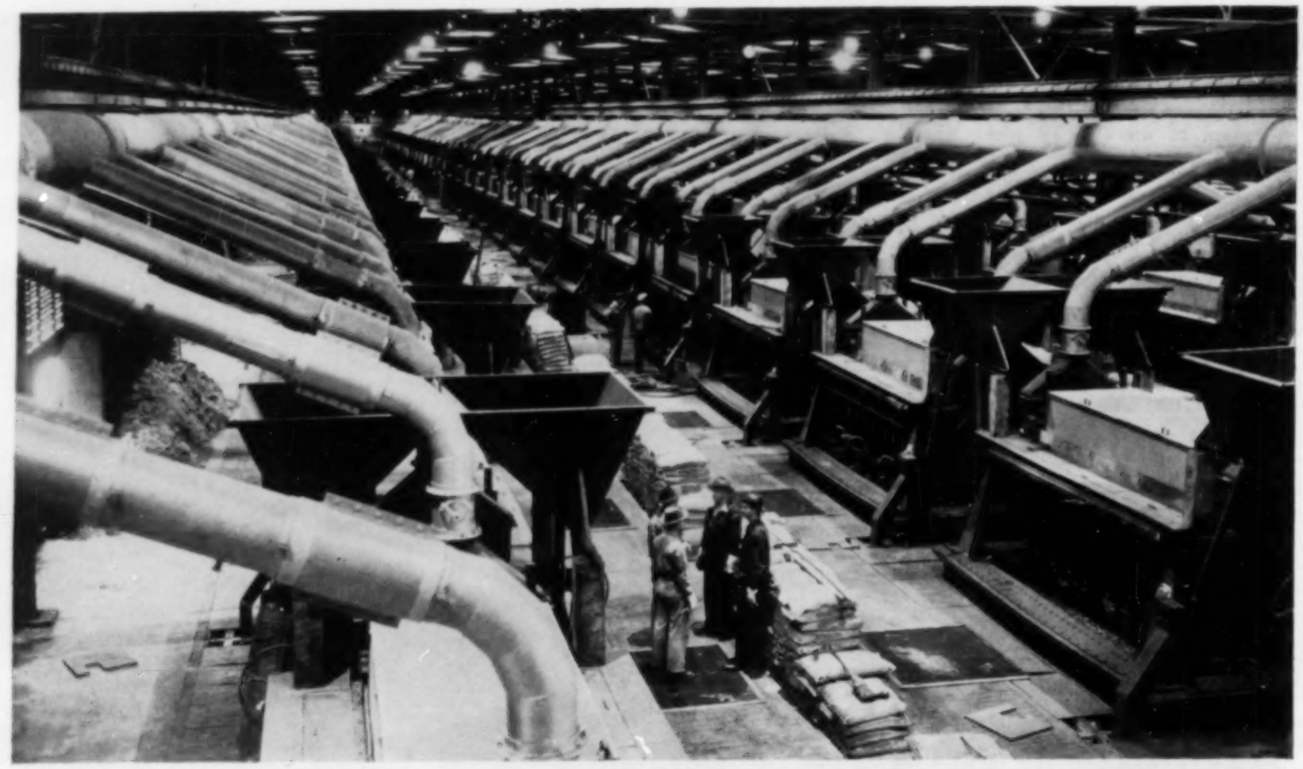
An idea as to where the metallic aluminum goes is obtained from the following 1950 tabulation made by a major primary producer: Building products, 19 percent; transportation, 18 percent; cooking utensils and household appliances, 14 percent; machinery, general and electrical, 4 percent; power-transmission conductors, 8 percent; unclassified fabricators and for further processing, 23 percent; all other uses, 14 percent.

People generally have long ago ceased to marvel at the end products of a mine-car of drab earth from 200 feet under the Arkansas grassroots or from Indonesian bauxite pits. Taking aluminum for granted may have caused us to overlook some recent revolutionary applications. The new transatlantic superliner, *United States*, has more than 2000 tons of aluminum in its construction, with the bulk of it in its superstructure.

The $8,000,000 General Petroleum Building in Los Angeles has some 16,000 windows shaded by vertical aluminum fins to screen out solar radiation. The fins act as conductors as well as shades, "piping" the collected heat to the top of the structure for release. Reports indicate an annual saving of about 300 tons of air-conditioning refrigeration as a result of this application. The United Nations Secretariat Building pictured in these pages is an outstanding example of the practical use of aluminum in the construction of large edifices.

Aluminum alloys that combine lightness with strength have stepped into the field of strong structural shapes and plates. Mine cages and cars, draglines, booms, shovel dippers, traveling cranes and bridge floor systems are among the newer structural applications. The economies thus effected are important. The new bridge across the Saguenay River between Arvida and Shipshaw, Quebec, Canada, is a shining example. The weight of the 504-foot-long span would be twice as much as it is had it been built of steel, and this does not take into consideration savings in the weight of foundations and trusses, in labor, freight, etc. Maintenance is also expected to cost less.

Airplane manufacturers have for a long time been large-scale consumers of aluminum. It has recently been pointed out that approximately 75 percent of the total weight of every craft—military or civilian—is aluminum. The B-36 Air Force bomber incorporates some 50 tons



FROM ALUMINA TO ALUMINUM

Shown above are long rows of electrolytic cells or "pots" where, by the Hall-Heroult process, the magic of electricity reduces the aluminum metal from pure alumina, or aluminum oxide, dissolved in cryolite. Each cell turns out only about 500 pounds of aluminum a day, so large numbers of them are needed. The overhead pipes remove the fumes given off during the process. Because about ¾ pound of carbon electrode is consumed for each pound of metal produced, electrodes have to be replaced with frequency. A carbon anode is being renewed in the picture at the right.

of the metal! However, planes are not the only military products that make a heavy demand on aluminum. Included among them are: rockets and the new 3.5-inch bazooka and other rocket-launching equipment; walkie-talkies, radar equipment, and towers for the national radar screen; boats and ships of all kinds, amphibious vehicles, unloading ramps and related assault equipment; tactical and floating bridges; airfield landing mats and fire control towers; water and fuel tanks, shipping containers as well as pipe lines; construction machinery; field kitchens and mess kits; foil for packaging food and metal parts; portable shelters, GI helmets, firearms and other things too numerous to mention here.

Primary aluminum works expect an aggregate expansion in capacity that will push production beyond 1600 million pounds in 1951 and 2200 million pounds in 1952. They will be crowding the World War II peak, which was held for a short time in 1943 at an annual rate of 2350 million pounds, and better the total yield for that year, which reached 1,840,141,121 pounds under "never-mind-the-cost, produce-the-aluminum" conditions. Both military and civilian requirements were oversupplied, accounting for the immediate decrease in output and the curtailment or closure of some of the war plants. On a volume basis, the production of aluminum ranks second only to iron and steel and has soared ahead of the combined cubic footage of copper, lead and zinc.

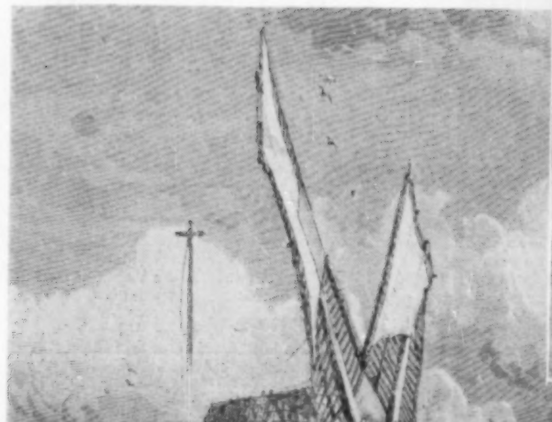
Two newcomers will enter the field—Harvey Machine Company, Inc., fabricator of extruded aluminum products, plans a primary aluminum plant in Montana, and the Apex Smelting Company, maker of secondary aluminum ingots, has purchased facilities for primary production in the Southwest.

New deposits of bauxite, additional producing companies, new sources of electric power, expanded beneficiation and reduction facilities, and an ever-increasing market bolstered by unrelaxing research indicate a bright future for the country's aluminum industry.

Power from the Wind*

Penrose S. Albright†

EWING GALLOWAY



THE BETTMANN ARCHIVE

HISTORIC AMERICAN MILLS

The picturesque windmills at the left served Easthampton, Long Island, more than eighty years ago. The mill at the top is reminiscent of colonial days. It stands in Greenfield Village, reconstructed by Henry Ford to perpetuate America's past. It was moved there from its original site near Barnstable, Cape Cod, and restored as it was in 1633 when built by the pilgrims to grind corn.

FOR a long time I have been convinced that a comprehensive research project intended to make more and perhaps much use of Kansas winds should be undertaken. The use of wind for power purposes has been on the decline during the past century. Ships once driven by sail are now steam and diesel driven; windmills used for pumping water are losing their popularity in favor of gasoline and electrically driven pumps; windmills used for grinding grains have disappeared. There has been a small resurgence of wind power use in the small wind driven electric generator-storage battery systems used to electrify remote farms. However, these devices do not seem to be able to withstand the competition of the rural electrification program in areas to which that program has spread.

During this same one hundred years Kansas and the rest of the Great Plains country has been settled and developed. Until recently, this, our area, has been pre-eminently agricultural and oil producing in its economy. Only of late have we been making a conscious effort to balance our agriculture with industry. I make this statement because it is only now for the first time that engineering and manufacturing skills and facilities are becoming available for manufacturing wind driven equipment in this area if such manufacture should appear feasible.

During a dust storm or times of just plain high winds we Kansans are wont to curse the wind and wonder why we continue to live in what seems at the moment like such a forsaken place. We have all heard of an early settler who homesteaded a farm in Kansas. A year

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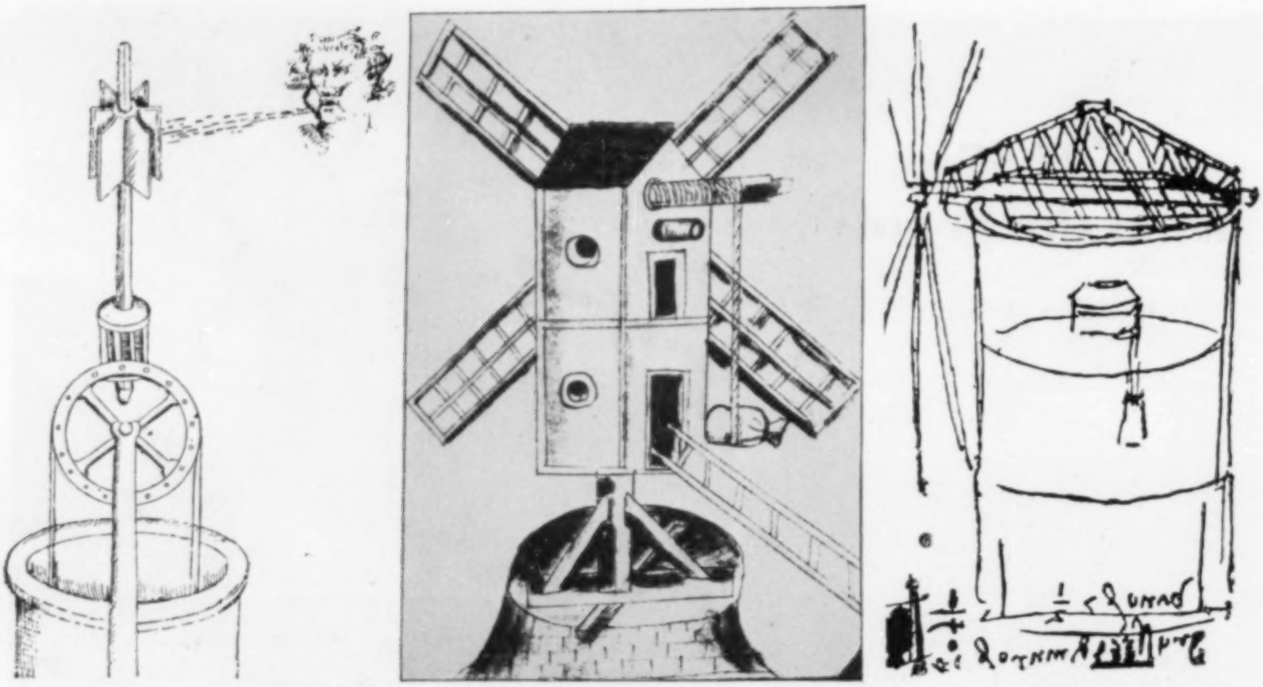
*Delivered May 4, 1951, as the presidential address of the Kansas Academy of Science under the title "Should We Re-examine Our Kansas Winds?" Printed in Transactions, Kansas Academy of Science, Vol. 54, No. 2, 1951. Reprinted by permission.

†Professor of Physics and head of the department, University of Wichita, Wichita, Kans.

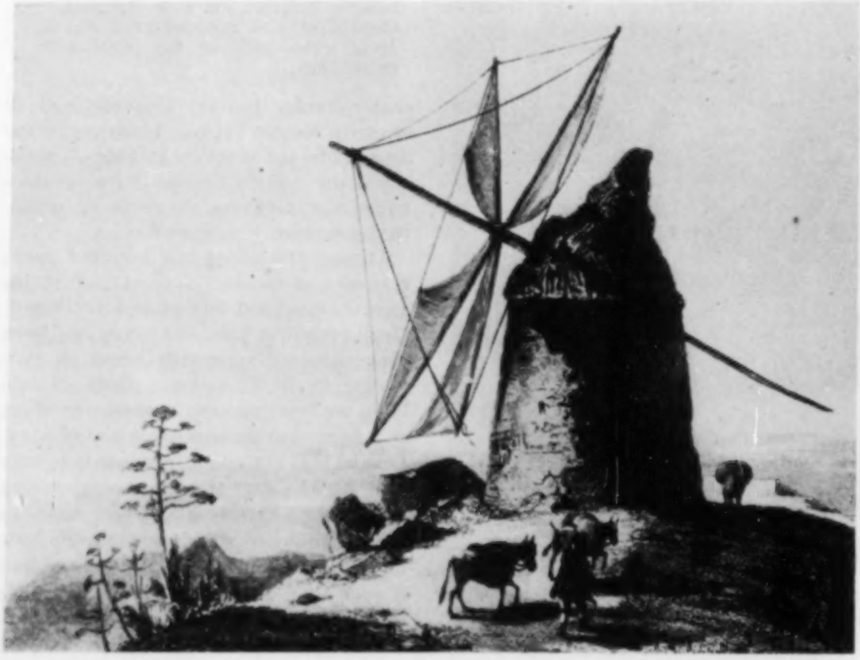


THE BETTMANN ARCHIVE

USE OF WIND POWER AGE-OLD PRACTICE

At the left is a reproduction of a drawing of a wind turbine raising well water with counterbalanced buckets. It is attributed to Simone di Mariano (1483). The sketch in the center dates back to around 1430 and shows a post mill that could be turned as the wind changed. This type is said to have originated in Germany. Note the elevator to help the miller hoist the bags of grain. At the right is another conception of a windmill that was found among Leonardo da Vinci's voluminous sketches of mechanical equipment.

after homesteading it, he packed all his portable belongings and his family in his wagons and pulled out for the east from whence he had come, abandoning his homestead. When asked by his neighbors what was the matter, he replied: "It's this blankety blank wind, one day it blows everything to Hades and the next day it turns around and blows it all back again."



THE BETTMANN ARCHIVE

AN OLD-TIMER IN PORTUGAL

This engraving shows one of the most primitive forms of windmills. The canvas sails were adjusted by ropes, which were loosened and tightened much like sails on a boat. They could not be set to catch the wind because the structure was immovable. Later, mills were mounted on floats so they could be turned. The Dutch improved upon this method by building mills with revolving domes.

But this wind of ancient story will still be here ready to heat our homes in winter, air condition them in summer, plow our lands, and light and power our cities when our oil wells have run dry and our gas wells are memories. The wind, that is, will still be here. Will we by that time have learned how to use it?

One reason that our Great Plains winds may not have been employed more extensively may be because engineers and manufacturers in the industrial northeastern section of the United States have not very often had to lean against the wind when they walked out of doors. Perhaps if they had we would be applying the winds more than we are.

It is said in the United States our oil will last from 100 to 300 years and that our coal will last 3000 years.[1] It would appear too early to estimate how long our supply of uranium and thorium will last or even whether we will be able to use it on large scale power production.

Estimates on how long our fossil fuel supplies, that is our oil, gas and coal, will last must necessarily be revised as we become more reckless in their use, as our population grows, and of course, as unforeseen sources of these fuels are found.

We are now eating our petroleum. What I mean is this: In this area nearly all heavy farm work was done by horses

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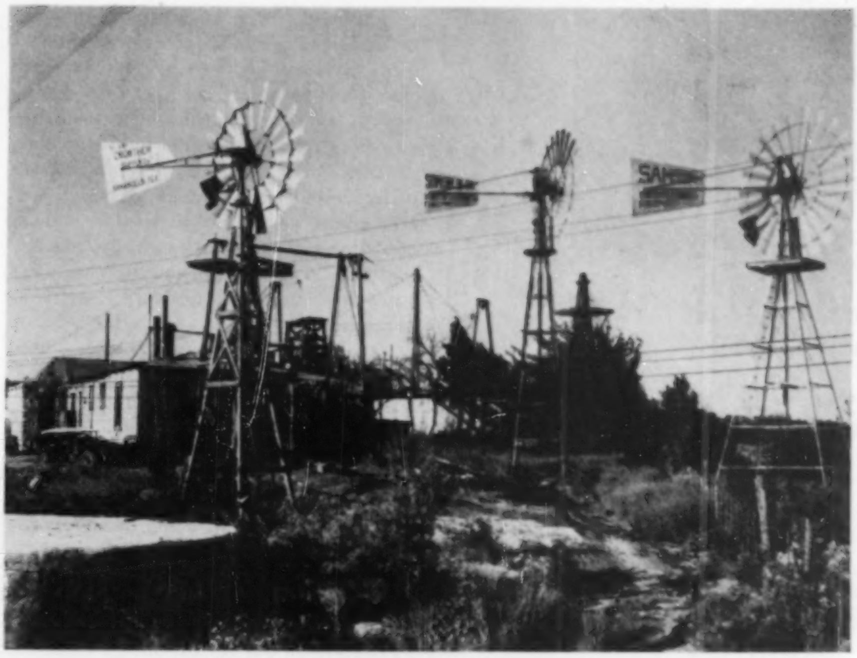
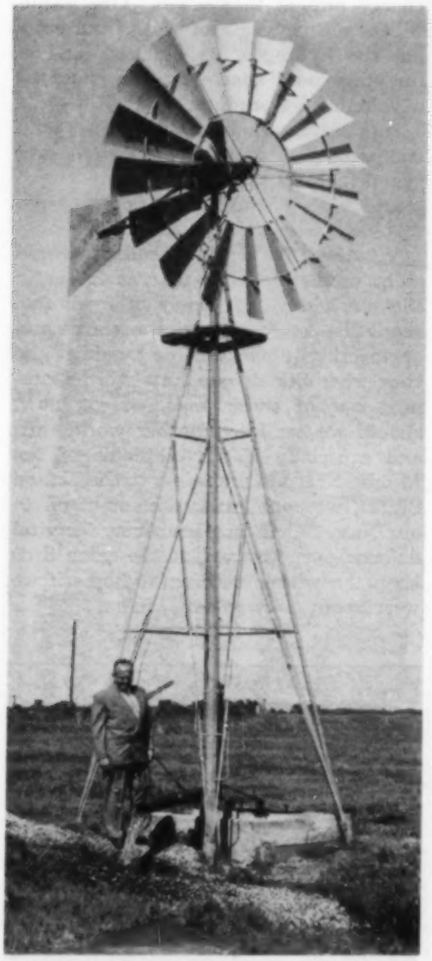
[1] Atomic and Solar Energy—Farrington Daniels—"American Scientist," October, 1950



EWING GALLOWAY



MODERN WINDMILLS

Without power from the time-honored windmill, some farmers and ranchers might be hard pressed today to provide water for household use and livestock, which needs a plentiful supply to keep it healthy. The structure at the bottom has a 10-foot wheel in gear and is shown pumping water for cattle. Prof. Penrose S. Albright, author of this article, is watching the flow at the base of the tower. Communities beyond the reach of public utilities also depend upon windmills to provide their water needs. The group at the right is the waterworks of Ozona, Tex., and draws upon deep wells. The mill at the left end is equipped with a motor so that it can be run when the wind does not blow.

and mules prior to about 1925. These animals were fueled with food produced on the farms upon which they worked. By 1935 our farms had pretty well changed over to tractor power fueled by petroleum products. The surplus corn, oats and hay thus released was for a time a surplus which glutted the market and contributed to forcing prices down and thus to the making of the great depression of the nineteen thirties. However the population of the United States has increased now to the point where we are pretty well using this extra food to feed our meat animals and our people. We are therefore now eating our oil in the form of meat and other foods. The time will come sometime when our oil wells will no longer produce and then it will no longer be possible to eat our petroleum. Either the animal food once fed to our power livestock will have to go back to them again or we must use humans for power or else new ways of powering our farms must be found.

We may turn to the liquefaction of coal for a time, but the more easily mined coal will go first leaving the less accessible coal for late comers. And when our coal, oil and gas are once gone they will be gone forever.

Prudence would dictate that we should be using them as sparingly as possible. Another reason for doing this is that they may prove much more valuable to the human race as sources of chemicals than as fuels. It is a shame to be using them as cheap fuels if they are in fact valuable chemicals.

Now when a scientist or engineer considers the use of wind he immediately meets two outstanding facts or problems. One is the fact that winds are variable and the other is that contrary to all the engineer's ingrained training he must practically forget mechanical efficiency entirely. Here it is of no interest in itself. In its place he must put economic efficiency, that is, how much energy he can produce at a certain cost. There is nothing new to the scientist or engineer about economic efficiency being the important item in a piece of machinery, but what bothers their thinking at first is that there is no necessary connection between mechanical efficiency and economic efficiency. There is a lot of wind, and it is all going to waste anyway.

Perhaps it was a lack of complete appreciation of this last fact that was the basic cause of the failure of a recent project on Grandpa's Knob near Rutland, Vermont.[2] In this project a group of competent engineers, including aeronautical engineers, designed and built a large power windmill on an experimental basis for an eastern company. They went to great pains and expense to design a two-bladed 1250 kilowatt test unit. The blades were 175 ft. from tip to tip. The blades were aerodynamically correct. The building site had been chosen after very careful and expensive research had been made to find a place where the wind conditions were optimum. They even went to the length of building miniature landscapes of the areas under consideration and placing them in wind tunnels for the purposes of finding the locations where wind speed-up was greatest. A 1250 watt generator and a blade pitch changing device and a special drive to prevent damage and other troubles due to fluctuations in wind velocity were designed and placed on the tower with the driving blades. All of this planning and construction was expensive and resulted in a well designed but untried machine. Like any new complicated machine it of course had defects which gave trouble, and after intermittent operation totaling about 1½ years of actual operation a blade failed, broke off, and the project was abandoned. It had cost 1¼ million of 1939-1945 dollars. Such a large turbine was especially sensitive to icing and other factors. The designers were so intent on high aerodynamic effi-

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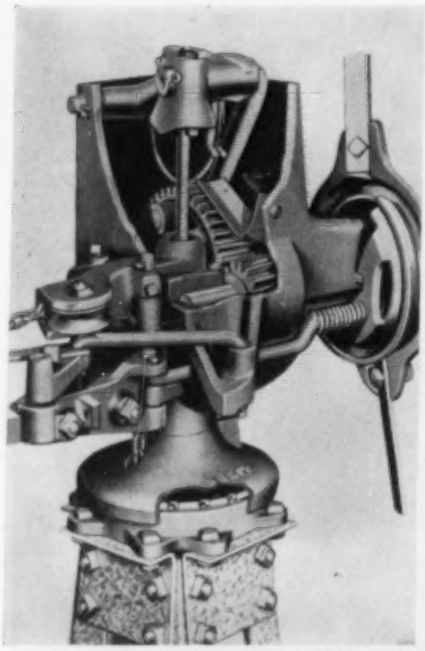
[2] P. C. Putnam, "Power From the Wind." New York, 1948.



BAKER MANUFACTURING COMPANY

WHAT MAKES IT REVOLVE

Cut-away view showing the gear mechanism and ball-bearing turntable of a typical modern windmill.

ciency and good engineering design that I wonder if they may have lost sight, in part, of rugged strength and dollar efficiency.

In harnessing air power, variability of wind presents engineers and scientists with their greatest problem. They must find some way to store the energy over the periods of light winds and calms. Many possible methods present themselves. A successful method must be an inexpensive method. That is an absolute requirement.

The use of storage batteries would appear to be too costly a method for general use. However, one line of investigation that would seem well worthy of following would be one intended to produce as an end product a really long lived and not too expensive storage cell, a cell intended to be used in batteries to store energy from wind. There would seem to be promise in that direction.

Another method of storing wind energy that immediately presents itself would be to use wind power to pump water from a low reservoir to a high one and then run the water back as needed through water turbines driving electric generators. A little reflection however shows that this idea may advantageously be given a different twist. Wind power could be used to produce electrical energy. During periods of sufficient wind this energy could be substituted partially or wholly for the electrical energy normally produced by a hydro-electric plant. Since the hydro-electric plant could thereafter partially or wholly shut down during windy periods it could save water during these periods and hence use water at a faster rate during periods of calms than it otherwise could. Thus it could produce electrical energy at a faster rate during periods of calms without the necessity of enlarging its reservoir or water shed or both. In this way a combination of hydro-electric plant and a wind-electric plant could produce more power continuously than the hydro-electric plant could alone. This method amounts to a storage of wind energy and was the scheme which the Grandpa's Knob group had in mind and actually used on an experimental basis. This method would seem to be a very practical one. The same general idea could also be applied to the storage of wind energy by saving coal, oil or gas supplies normally used by a steam-electric plant.

A method of capturing wind energy to be used in a similar scheme in Kansas that would be worth investigating would be to think in terms of a windmill of the general type and size that has proved so rugged on our farms, except designed to compress air instead of pumping water. Suppose such a unit were worked out to produce five or ten horse power[3] and then made on a mass or limited mass production basis. Suppose further that such units were strung out in an appropriate line of locations with the air compressed by these units being piped through an ever enlarging main to a compressed air turbine-electric plant located with a large steam-electric or hydro-electric power plant which was already manned by the usual crews. The compressed air main would constitute a small compressed air storage reservoir and wind fluctuations absorber. The same crews used on the steam or hydro-electric plant could perhaps be partly diverted to operate the air turbine-electric plant during periods of available wind. It would seem that there are possibilities in such a scheme.

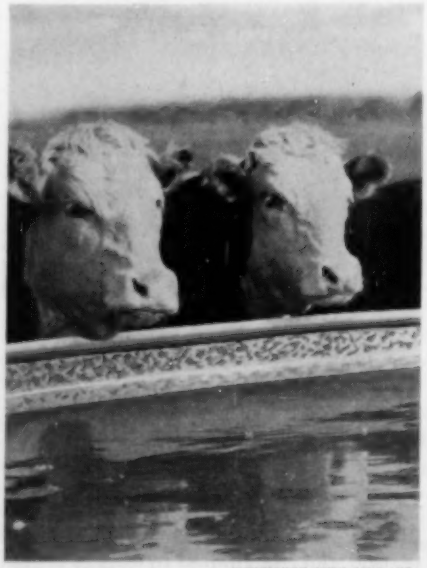
Along this line I would like to see some Kansas manufacturer or manufacturers make a beginning in this direction by either building for sale an air-compressing windmill or an air-compressing pump to be driven by windmills now available commercially. With an appropriate compressed air storage tank, if the selling price could be kept reasonably low, such a machine would be valuable on a farm or ranch for many things including keeping the many pneumatic tires now found on the farms and ranches inflated and in the pumping of water by the very simple airlift pump principle.

Such a beginning might also be a beginning toward an inexpensive production of liquid air. I am convinced that appropriate research could develop very cheap methods for producing liquid air and I would like to see research with this purpose as the objective carried on in some of the industrial research institutes in this area. If such an objective could be gained and if wind power could be used to power these devices, then liquid air could be stored for short periods and used to drive tractors to farm our land and move our trucks and automobiles and it might incidently prove to be a surprisingly attractive source of power for airplanes under some circumstances. Such an end would be a victory well worth striving for.

Many other methods of storing wind energy present themselves. One would be the electrolysing of water and storing the hydrogen, to be used as fuel for power and heat. Oxygen could be a valuable by-product.

Another method would be to pump compressed air into played out natural gas fields and then release the air so stored at a steady rate out through turbines driving electric generators.

Whatever the method, prudence would seem to dictate that Kansas living in the plush days of plenty of fossil fuel should be conducting wind research and engineering developments against the time when our descendants will be running out of those fuels. Even now, should we get into another world war, and especially if the oil fields of the Middle East should be lost to the United States, we could release a lot of oil to our Navy, Air Force and Army for vital defense purposes and at the same time keep the wheels turning at home if we were ready to use our winds.



DEMPSTER MILL MFG. CO.

PUMPED BY WINDMILL

Cattle lose weight if they must walk far for water. It is the most important item in their ration because milk is 87 percent water.

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[3] Power in the wind, that is the unattainable maximum, is given by the equation:

$$\text{kilowatts} = 2.14\,\rho\,AV^3 \times 10^{-3}$$

where ρ = density of air in slugs per cubic foot, A = projected area swept by turbine in square feet, V = wind velocity in miles per hour. From Putnam, "Power From the Wind."

The Great Uranium Search

Quest for the Miracle Atomic Mineral Gathers Force in the West

P. J. Colwell

CORE DRILL ON LOCATION

The diamond drill has played a leading role in uranium exploration on the Colorado Plateau. The truck-mounted rig shown is typical of those used. Lower-cost wagon drilling, with the cuttings being recovered for samples, has replaced core-drill operations where only the location and grade of the ore are sought and where explorations are carried to depths of less than 45 feet. For careful and more complete geological and mineralogical appraisal of an area to any considerable depth the diamond drill is still widely utilized.

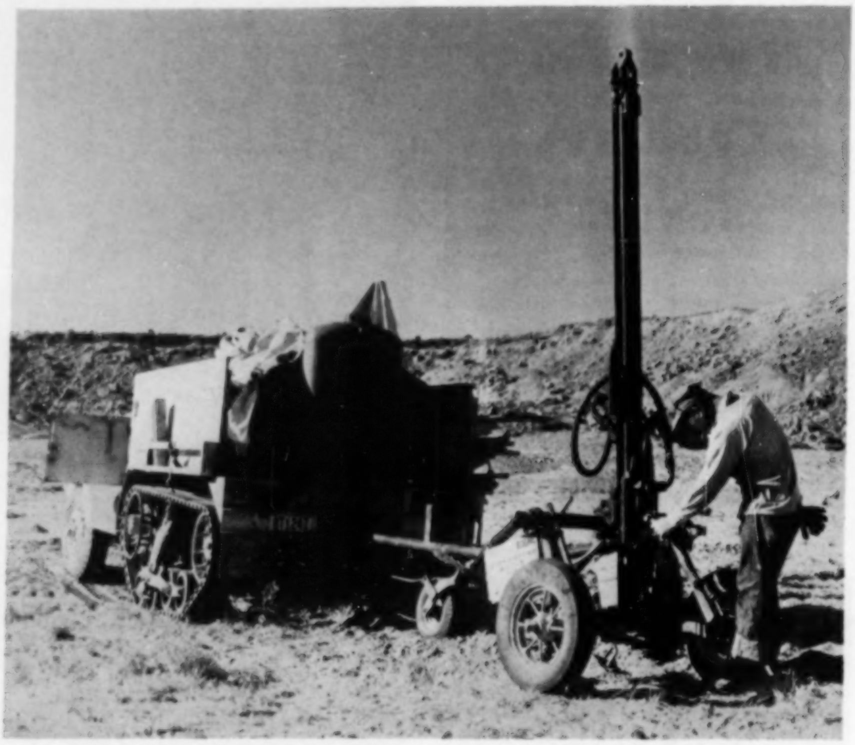
ROAD BUILDING

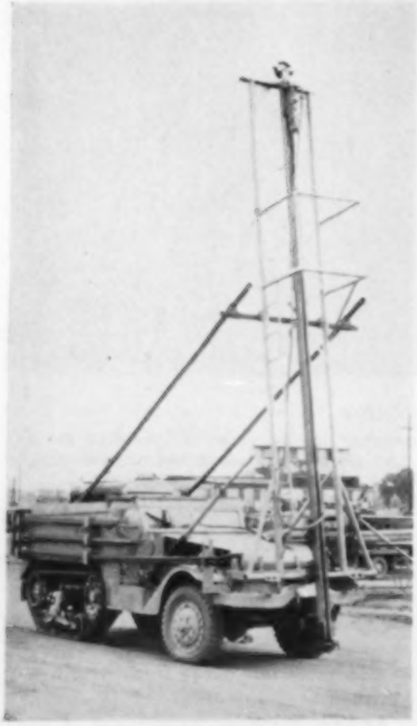
Literally pushing a road into a uranium deposit, this bulldozer is operating in a typical Colorado Plateau setting. Men and pack animals can get anywhere on the plateau, jeeps and half-tracks can reach most of the ore occurrences, but before mining can proceed very far at any location it is necessary to build an access road.

PADDY MARTINEZ is not a prospector, geologist or mining engineer, but he found an important deposit of uranium ore. Paddy, part Navajo Indian and part Spanish, is a 59-year-old sheep raiser near Grants, N. Mex. In town one spring day in 1950, he overheard a conversation between two prospectors concerning a reward the Government was offering for the discovery of uranium-ore deposits. He saw a piece of yellow rock that they said was uranium ore. Paddy kept his eyes open for yellow rock in the grays, browns and reds of the sandstone and limestone formations he rode over tending his sheep. At the base of Haystack Mountain, some 14 air miles northwest of Grants in west-central New Mexico, he came upon some yellowish rock that looked like that the prospectors had displayed. It was found to be a secondary uranium mineral—and there was a lot of it.

Paddy's discovery may prove to be a major factor in our struggle to become self-sufficient in uranium source material. Too much of our uranium (about three-fourths) is still shipped to us from the Belgium Congo via sea lanes that are perilous in wartime. There are trickles from other foreign countries and from Canada, but the Atomic Energy Commission, charged with keeping the United States ahead in the atomic-weapons race, will not be satisfied until we can meet our needs from within our continental boundaries.

All our domestic production of uranium ore now comes from the Colorado Plateau, a physiographic province of some 130,000 square miles in eastern Utah, northeastern Arizona, northwestern New Mexico and that portion of Colorado west of the Rocky Mountains. That vast area, 5000 to 7500 feet above sea level, is covered almost entirely with a thick, generally flat series of sedimentary deposits with sandstones and shales predominating. Some 40,000 square miles of the plateau are known to contain carnotite, a secondary uranium-vanadium mineral. The ore occurs irregularly in formations representing geologic ages from Permian to Tertiary, but concentrations are found in rocks of the Jurassic and Triassic eras. The zone of higher-grade mineralization, called the Uravan mineral belt, extends for a dis-





HALF-TRACK EXPLORER

Units such as these solve the uranium explorers' transportation problems on the Colorado Plateau. These two are used by Mineral Engineering Company, of Grand Junction, Colo., which developed the rig shown at the bottom. Its extended Ingersoll-Rand drill mounting is hinged so it can be laid back on the vehicle when it is being moved. A diesel-powered I-R compressor occupies the bed of the half-track, and all accessory equipment for exploratory drilling at remote locations is packed in and on the mobile unit. The other half-track pictured is similarly outfitted, except that it pulls a standard Ingersoll-Rand JHM lightweight Wagonjack. Wagon-drill rigs, introduced in 1949 and capable of drilling to depths of 30 or 40 feet, have greatly benefited the plateau development work. A saving of from 50 cents to $1 a foot, as compared with diamond-drilling costs, has appreciably extended the scope of the exploration program.

tance of about 50 miles and is from one to several miles wide.

The Grants deposit, as at present developed, lies mainly in a thin layer of limestone—named Todilto Limestone—between two sandstone members of the Jurassic-age series that host the best of the Colorado Plateau enrichment. Atomic Energy engineers and geologists have found that the area of uranium mineralization occurs in scattered tabular lenses throughout a considerable expanse of country.

The ore from the plateau, as delivered to mills for processing, averages about 0.25 percent uranium oxide and 2 percent vanadium pentoxide. Roscoelite, a vanadium-bearing mica, occurs in varying concentrations and is often associated with carnotite as a minor component. In the Grants deposit we have a different mineralogical picture. Early investigations have led to the conclusion that tyuyamunite, a calcium carnotite, will be the predominant mineral there. Carnotite also has been positively identified in that district, as have uranophane, gummite (both of which are secondary minerals) and pitchblende, the mother uranium mineral. The vanadium content of the ore is very small compared with that of the ore mined in the plateau area, where it is customary to produce vanadium of an appreciable marketable value.

Pitchblende is the object of considerable interest in the case of the Grants deposit in that, theoretically, it has little or no business there. Found in blebs up to 3 millimeters in diameter and surrounded by concentrations of the secondary minerals listed in the preceding paragraph, it is an unexpected prize in this aged sedimentary formation. Thought to be strictly a primary mineral, except in instances where it occurs as a secondary mineral in metalliferous veins, its origin and how it reached that resting place serve as food for thought for the geologists and engineers charged with an explanation.

Private enterprise is producing this nation's domestic uranium ore, but two government agencies have been largely responsible for setting up conditions whereby it can be mined profitably. An adjusted price for the output was a necessary incentive in these highly speculative ventures, and exploratory work beyond the economical limits of private operators was required in most cases. The Atomic Energy Commission, which not only promotes development but also controls the commerce and security of the radioactive-materials industry, has kept field men busy determining the geologic features of the Grants deposit ever since it was discovered.

A logical coworker is the U. S. Geological Survey, which began investigations in the plateau area in 1939 and since 1947 has been pursuing an active exploration program there on behalf of the AEC. It has done an outstanding job of mapping its geologic features and interpreting them as guides to ore bodies, operations in which more than 2500 holes have been drilled.

Imagine finding a log worth thousands of dollars! That's been the fortunate experience of some operators on the plateau. Little wonder, then, that the uranium districts have attracted prospectors and miners much as gold camps lured them in the past. Ore bodies in the principal plateau producing zone are invariably associated with organic matter in the form of fossilized tree trunks, branches and leaves. These remains of ancient forests were fossilized by the replacement of their organic constituents with uranium and vanadium minerals and are now often found to be the richest source of carnotite. The presence of these carbonized plants in the mineral-bearing sandstones, when properly evaluated in conjunction with other criteria, is a sign of the presence of ore.

The present exploratory work being done at Grants by private enterprise and the agency of the government will result in a preliminary appraisal of the deposits. Time, more investigation and extraction will write the later chapters about the new field. It has been determined, as already mentioned, that the ore bodies there are distributed in small, irregular, lenticular, vaguely defined areas as in the Colorado Plateau, where a deposit yielding more than 10,000 tons of ore is considered large. But it is too early to say that the ore will roll, pitch, thicken and pinch with little or no warning, as is characteristic of the plateau bodies. It is too early to know if the Grants occurrences are directly related to the plateau mineral deposition . . . the present concensus being to the contrary.

It is a fact, however, that transportation difficulties and scarcity of water will not be the deterrent to production that they are at so many of the plateau operations, where 60- to 80-mile hauls of ore and water over poor roads are common. Owing to the more subdued topography in the Grants area the deposits will be readily accessible, and as there is an abundance of subsurface water nearby the expense of supplying enough for mining will not be a large item in the long list of production costs.

It was expected that metallurgical problems would be experienced with the Grants ore, but they have been minimized through early experimental work. It was feared at first that the discovery might not yield recoverable uranium because the acid leaching process used on much of the plateau sandstone and shale ores was not applicable to limestone ores. However, the plateau mills also employ a soda-ash leaching method and that apparently is suitable for treating the secondary minerals from the Grants district.

Who owns the land upon which Paddy Martinez found uranium? The Sante Fe Pacific Railroad Company, a Santa Fe Railroad Company subsidiary, owns some of the land, which is along its right-of-way. The Navajo Indians hold title to some sections. Small acreages belong to individual ranchers, and a large portion is the property of the State of New Mexico and is open to mineral location. As news of the discovery spread, Grants became a busy town. Prospectors, scouts for major mining companies, AEC representatives and speculators hurried in to look the new field over. There were many squabbles; but, complicated though the land status was, subsequent surveys established all the boundaries and the confusion subsided.

It was determined by survey that Martinez's discovery was on a section of the Santa Fe. Early in the uranium rush Thomas O. Evans, mining engineer for the railroad, made an inspection and recognized the potential value of the deposits. The company's president, Fred Gurley, came from Chicago to go over the ground and left instructions with Evans to sample, evaluate and report on the ore bodies located on Santa Fe property as rapidly as possible. Thus "Operation Haystack" was born.

MEN WORKING
W. BISHOP

"Confidentially, lady, I'm looking for uranium."

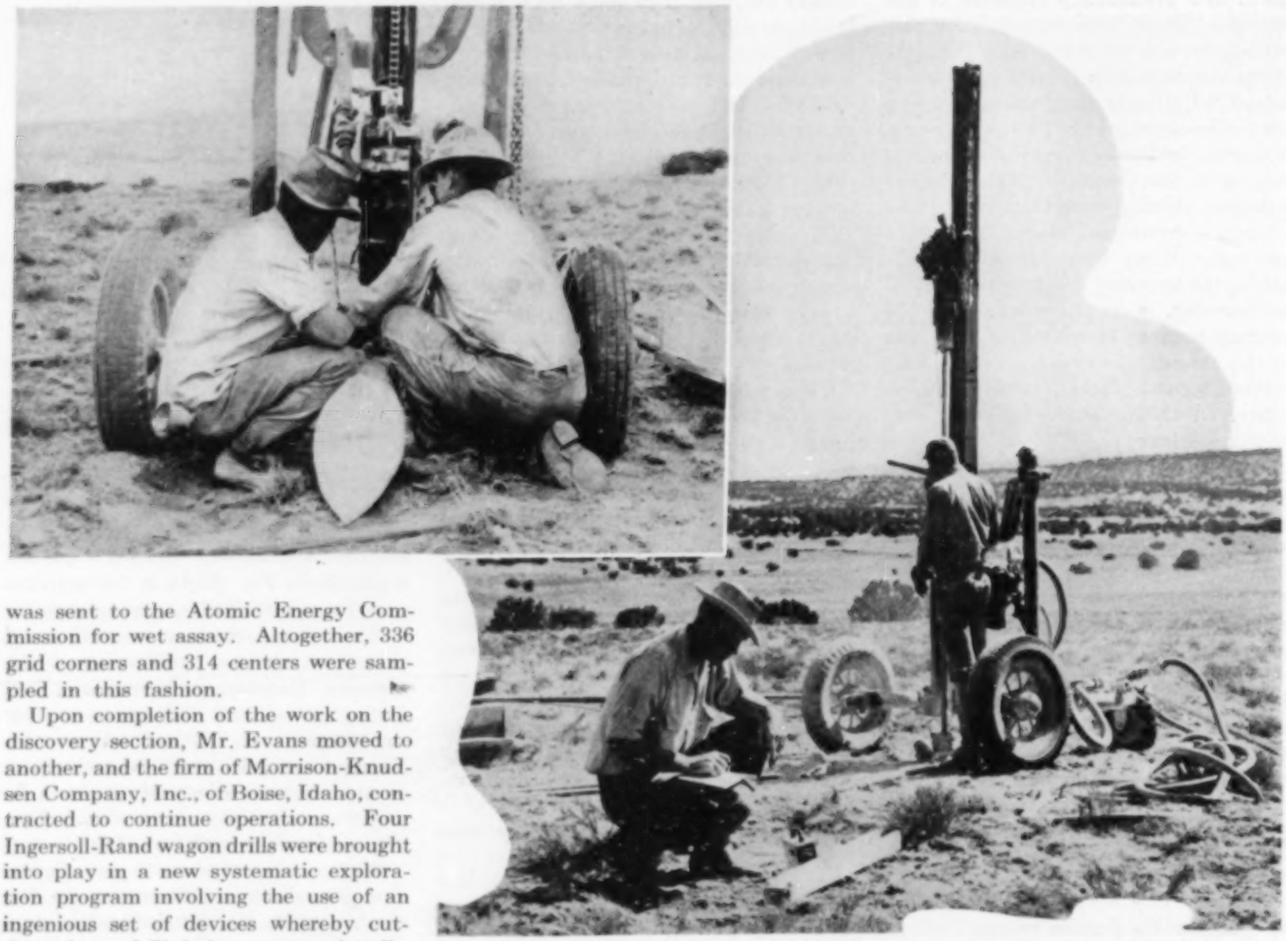
SAMPLES FROM PITS

Some of the uranium-bearing Todilto Limestone of the Grants area in New Mexico underlies only a few feet of mixed sand and clay and is easily exposed by a bulldozer for sinking sampling pits. The loaded ore boat shown contains material taken from a 2-foot vertical section of such an excavation. It is being checked for radioactivity by two engineers with a scintillometer preliminary to processing it in a nearby crusher-sampler. The mounds in the background are overburden that has been removed by bulldozers from similar sampling points on the deposit.

With a crew of some 70 men, Operation Haystack got underway in December, 1950. The hurried task of mapping, sampling and assaying started with a 90-acre tract on the discovery section. It was surveyed by a grid system, on 100-foot intervals, and sampling points were established at intersections and in the center of each grid. But before any sampling was done, a contour map and a chart showing scintillometer (an instrument for measuring the degree of radioactivity that is more sensitive and accurate than the Geiger counter) anomalies were prepared.

Frank Shufflebarger, an Albuquerque, N. Mex., contractor, put men and machines to work. After a bulldozer had stripped 2 to 4 feet of soil overburden from each grid center, Jackhamer crews began sinking 5x5-foot pits to depths ranging from a few feet to 12 feet in the Todilto formation, while wagon drills put down holes at the intersections. The pits were excavated in 2-foot vertical sections, and the rock was collected for assaying with each 2 feet of penetration. The entire sample from the average pit represented about 5 tons of material and went to a crushing plant. Dry cuttings from every 2 feet of hole sunk by the wagon drills were sent to the laboratory.

The 5-ton samples were crushed and split into 25-pound lots for the laboratory at the nearby operation headquarters in Prewitt. Radiometric assays were run on a portion of each 25-pound specimen, as well as on the samples of the drill cuttings. Every tenth specimen



SAMPLING DRILL CUTTINGS

Landowner Santa Fe Railroad and contractor Morrison-Knudsen Company, Inc., developed a unique sampling method for the Grants exploratory work. Drilling dry with a full head of air passing through the drills normal water course permits continuous sampling of the material penetrated. The operation is conducted as follows: In a 12-inch-deep hole drilled with an oversize bit is set a piece of 4-inch pipe, its upper end protruding about 6 inches above the surface. Drilling is done through this sleeve, to which a 2-inch pipe is welded at an angle near the top. Attached to this arm is a vacuum-cleaner bag, as shown in the center-foreground at the top. A canvas hood fitted close to the drill rod and hanging over the sleeve opening deflects the cuttings into the bag. Samples are collected in this way for each 2 feet of hole drilled. In the illustration at the bottom a technician is taking a Geiger-counter reading on a sample of cuttings spread evenly in a control box. If radiations from the specimen register above a fixed minimum on the counter, the sample is properly labeled and sent to the laboratory.

was sent to the Atomic Energy Commission for wet assay. Altogether, 336 grid corners and 314 centers were sampled in this fashion.

Upon completion of the work on the discovery section, Mr. Evans moved to another, and the firm of Morrison-Knudsen Company, Inc., of Boise, Idaho, contracted to continue operations. Four Ingersoll-Rand wagon drills were brought into play in a new systematic exploration program involving the use of an ingenious set of devices whereby cuttings from drill holes are continually collected for analysis. In the initial application of this method the four units drilled holes at the rate of about 16,000 feet per month. They ranged in depth from 30 to 40 feet, depending upon the thickness of the overburden and of the Todilto limestone. By a third exploratory system followed by the Santa Fe mining division, a 6x8-foot shaft is sunk and 5x7-foot drifts are driven in the ore from the shaft bottom.

At one place on Santa Fe land carnotite ore is exposed in the Morrison (Jurassic-age bed in which lie most of the producing plateau deposits) sandstone formation which, stratigraphically, is about 400 feet above the Todilto Limestone at Elevation 6900-7000. There Mr. Evans is confining operations to trenches a few feet deep from which closely spaced holes will be drilled to determine the vertical extent of the ore. To facilitate exploratory work at a remote point such as this, a half-track unit equipped with a compressor and a wagon drill has been added to the equipment.

A large amount of capital, research and know-how are directed towards bringing this mesaland of west-central New Mexico to the production stage. A major mining company is carrying on a program similar to that of the Santa Fe Railroad, and some 30 individuals and small groups have holdings on which they are working towards shipments to a mill. Smaller beginnings than this have often resulted in colossal developments.

Back in 1900, when carnotite was in demand for the extraction of radium, the Colorado Plateau was the scene of activity and continued so until 1924. From then on to 1940 the carnotite-roscoelite ores were mined principally for their vanadium, which was growing in importance as an alloying ingredient in steel. The tailings of old radium and vanadium mills yielded some "quick" uranium values when that element was badly needed during World War II.

Government initiative in the early years of that conflict resulted in an upswing in vanadium mining with a corresponding increase in by-product uranium. By 1944, however, vanadium requirements had been met, and by 1946 the plateau operations were practically at a standstill. The atomic age alone is responsible for the present vigorous and systematic development of that area, for it took the Government's 1948 uranium-vanadium buying program to bring ore again out of the hills and off the rim rock. With this profit incentive to spur them on, the fifteen operations and 55 men that constituted the 1948 mining force began to expand. Today there are some 200 different producers employing well over 1000 men, and millions in private capital have been invested.

The Colorado Plateau may long be the uranium production center of the United States. In addition to these immeasurable reserves, noteworthy uranium enrichment has been discovered on the fringes of that mineralized area. Late in 1948 a prospector made a strike near Marysvale, Utah, some 150 miles south of Salt Lake City and northwest of the plateau. This has turned out to be a big section containing two secondary uranium minerals—torbernite and autunite. Surface shipments have averaged about 0.3 percent uranium oxide, and some ore taken from a depth of 100 feet averaged 0.8 percent. Pitchblende is beginning to show at that level, and hopes are high that a large quantity of that rich mineral may be uncovered.

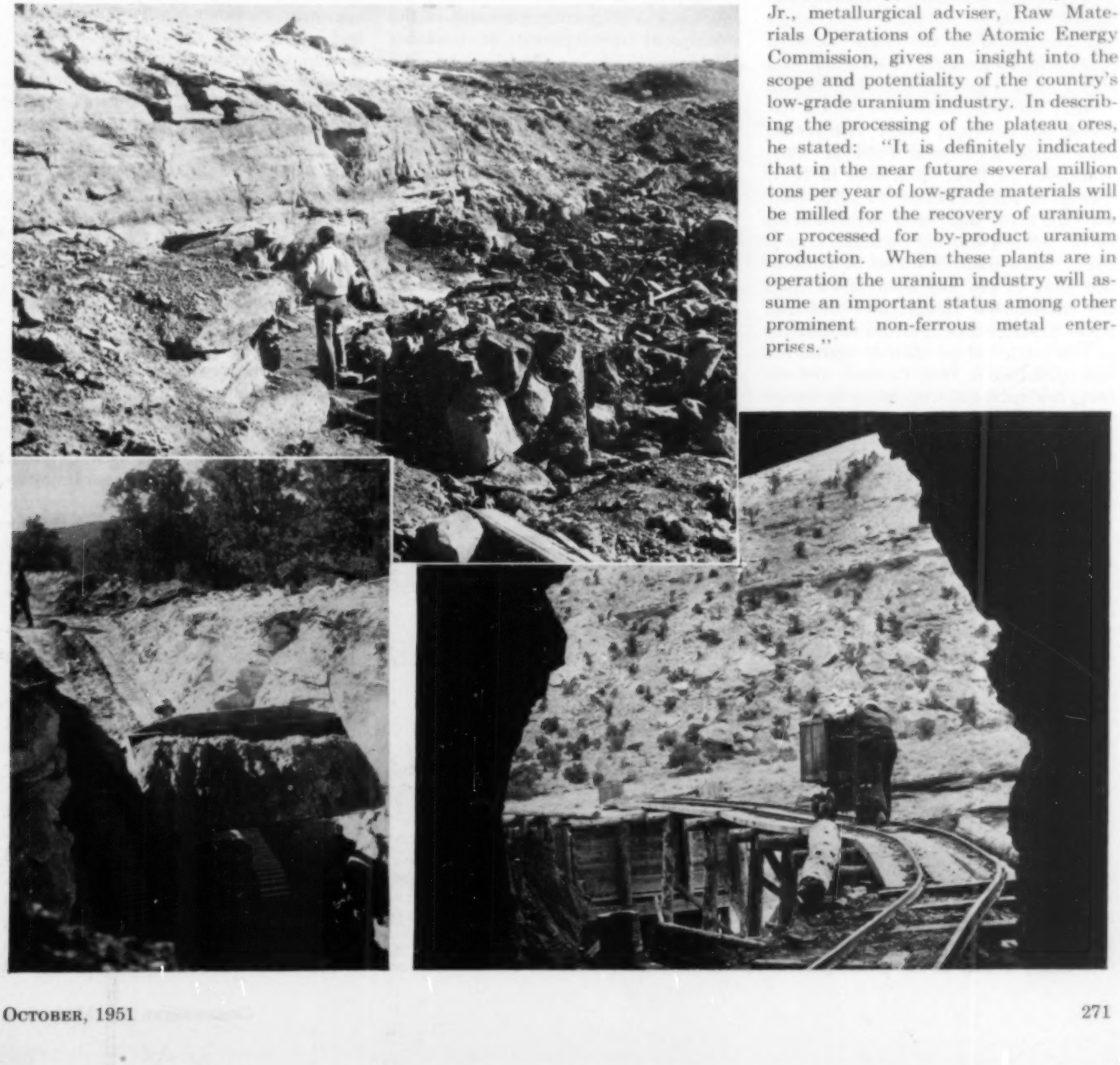
In mid-1950 carnotite was found on the southern border of the plateau and on the Navajo Reservation near Shiprock, N. Mex. That was acclaimed by an official of the Atomic Energy Commission as "probably one of the most important carnotite discoveries on the Colorado Plateau during the last twenty years." And now Grants, some 120 miles south of Shiprock, comes into the limelight. Will it develop into a large uranium-producing field? Will it, together with the uranium from all other domestic areas, make this nation independent of all foreign sources of supply? There are promising indications of early yields from the Colorado Front Range, from the Coeur d'Alene mining district of Idaho, and from the upper peninsula of Michigan. In addition, low-grade deposits in Tennessee, Kentucky, Florida, Wyoming, Montana and Idaho are known to represent large reserves that can be recovered under emergency conditions.

There are seven uranium mills operating in the United States today, all on the Colorado Plateau. Five of them are located in Colorado at Durango, Grand Junction, Uravan, Rifle, and Naturita, and the others are at Monticello and Hite in Utah. They were concentrated there so that the cost of transporting the low-grade carnotite-roscoelite ores, which are being developed in widely scattered areas, could be reduced to a minimum. It is proposed that mills be built also at Marysvale, Shiprock and Grants.

In a paper delivered at the August 1950, Metal Mining Convention and Exposition of the Western Division of the American Mining Congress held in Salt Lake City, Utah, F. W. McQuiston, Jr., metallurgical adviser, Raw Materials Operations of the Atomic Energy Commission, gives an insight into the scope and potentiality of the country's low-grade uranium industry. In describing the processing of the plateau ores, he stated: "It is definitely indicated that in the near future several million tons per year of low-grade materials will be milled for the recovery of uranium, or processed for by-product uranium production. When these plants are in operation the uranium industry will assume an important status among other prominent non-ferrous metal enterprises."

PLATEAU MINING METHODS

Colorado Plateau miners immediately work any deposit they locate if it promises to yield a profit. The technique employed depends upon the conditions encountered. The view directly below shows an open-pit operation where the ore extends to the surface. Where ore is exposed on the side of a steep slope an adit may be driven into it. The picture at the bottom-right was taken looking out of such an opening. When ore of commercial grade is discovered at depth by drilling, the normal practice is to go after it through an inclined shaft. A tractor shovel is seen at the bottom-left making the initial cut to collar such a shaft. Small workings like these, employing from two to ten men each, are the rule rather than the exception.



Iron-Ore Centennial

Michigan Communities Observe Anniversary of Mineral Discovery on the Menominee Range

WHILE engaged in subdividing a township in Marquette (now Iron) County, Mich., on August 8, 1851, Deputy United States Surveyor Harvey Mellen made this routine entry in his field notes: "52:00 to outcrop of iron 6 ft. high." (The figure 52 denotes the number of surveyor's chains from an established landmark.) The remainder of the entry is accepted as a record of the discovery or iron ore in what is now the Iron River District of the Menominee Range. Actually, there had been reports of iron-ore occurrences in the area as early as 1844, but Mellen's was the first one to give a definite location. That is why the district chose to observe its Iron Ore Centennial this year. From July 1 to 7, Iron River, Mineral Hills, Stambaugh, Caspian, Gaastra, and lesser communities along the range staged a rousing and successful celebration. On July 4 alone, attendance reached 25,000.

After Mellen's initial find, others followed, but not right away. Discoveries were made at Crystal Falls in 1861, Waucedah in 1866, Quinnesec in 1871, Vulcan in 1872, Florence in 1873, Norway in 1877, and Iron Mountain in 1878. Mining did not commence until 1881. Since then, in excess of 215 million tons of ore has been taken from the Menominee Range, and the Iron River District has contributed heavily to the total. More than 30 mines are still operating in Iron County, and experts are optimistic regarding its future productivity. In addressing the centennial gathering, Inland Steel Company's president, Clarence B. Randall, predicted that "iron ore will be mined in Iron River 100 years from today."

Harvey Mellen made no money from his discovery. He was employed by William Austin Burt, who contracted with the Federal Government in 1840 to survey the entire Upper Peninsula of Michigan. It is doubtful whether he even had the satisfaction of being around when mining was inaugurated with the opening of the Iron River Mine on the site of his find. Due regard was paid to his pioneering efforts by the celebrants, however. The entire region was a vast unexplored wilderness when he passed through it, and his vigilance in keeping an eye out for natural resources was of great importance in the subsequent development of northern Michigan.

The centennial was planned and executed by local people. In addition to the customary whirl of parades, dances, athletic contests, carnivals, firework displays and speeches, a pageant under the guidance of a professional director, a display of historical mining equipment, and a national-network radio broadcast helped make the observance successful. Both men and women of the district dressed for the occasion in nineteenth-century clothes and virtually all the men grew beards. Those who did not were hailed into kangaroo court or otherwise punished for their delinquency.

PICKANDS MATHER AND CO

ONCE IN A LIFETIME

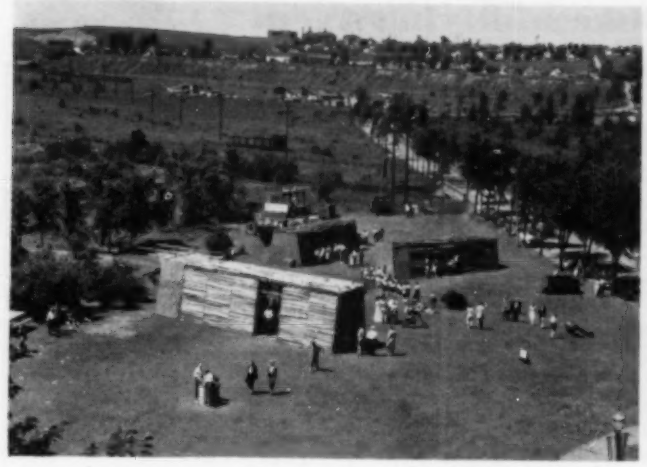
Miners took things easy during the celebration week. Here is a group of them riding a float in one of the parades that marked the centennial.

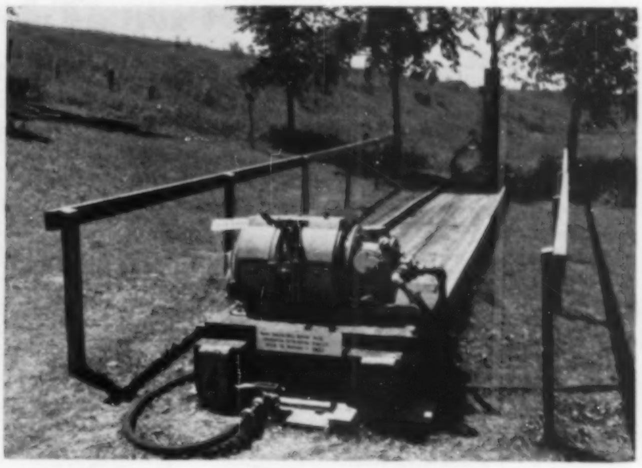
The historical pageant, Iron Ore-Rama, an elaborate presentation in nineteen episodes, unfolded the happenings on the range in the past 100 years. It began by portraying the original land surveys and Indian treaties that led to the Upper Peninsula becoming a part of Michigan by act of Congress. The Mellen discovery and the arrival of the first white settlers were depicted, and were followed by sketches that revealed life in the early communities. Featured were such pertinent scenes as the pioneer mining, lumbering, and agricultural ventures; the coming of the railroad; the first school, the dances of the times, the advent of the automobile, World War I, the depression, and World War II. A grand finale presented a review of past achievements, current life in the district, and a glimpse into the future.

Caspian's city hall served as the nucleus of an exhibit showing a century of evolution in mining methods and equipment. Safety devices, machinery, sectionalized plan maps of mines and other objects of educational interest were displayed. Outside, one of the major operators, Pickands Mather & Company, had set up exhibits on three acres of ground to demonstrate the working of typical pieces of mining equipment. Drilling, machine loading of muck, slushing, and other operations were carried out in improvised mine sections, and compressed air and electricity for the purpose were supplied from the Caspian Mine some 2400 feet away.

As is true of most mining regions, the Iron River District has had a colorful and eventful history, and the centennial provided an occasion for recalling outstanding episodes. At the time of its founding, a few villages of Menominee and Chippewa Indians were scattered throughout the country that was destined to yield fortunes from iron ore and forest products. Following the initial discoveries, the Indians were quick to recognize an opportunity to improve their financial status. It was a common practice among them to bring specimens of high-grade be-wa-bic (iron ore) into a new settlement and offer to reveal its source for $100. Many mines can trace their origins to such transactions, in which the white man was usually able to trim a fat slice off the Indian's asking price.

Not always, though, did the be-wa-bic turn out to be iron ore. A story is still told of an incident in 1877 that almost cost a settler's life. A civil engineer named Selden was informed by an Indian who lived at Chicagoan Lake that he knew where there was ni-shi-skin be-wa-bic—good iron ore. Selden agreed to pay $100 for a look at the occurrence, but made it plain that the ore had to be of good grade. After much delay, he was guided by the Indian and a companion across the lake, through a





OUTDOOR DISPLAYS

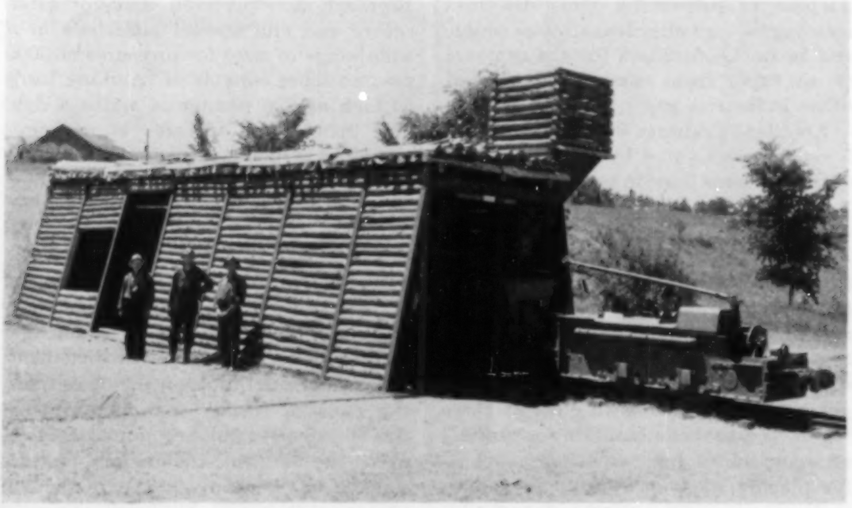
Timber structures set up in a field (left) represented drifts, stopes, and other underground mine openings in which machinery was run so visitors could see how ore is broken and extracted. One of the open-air displays showed underground ore loading or slushing by use of an Ingersoll-Rand air-operated hoist with an air-line foot throttle (top-right) that maneuvered a scraper on a timber slide. A 1901-model Rand drill, right, was a part of the "evolution of machinery" display. Note the tripod mounting with the heavy weights on the legs.

swamp, and up a ravine, where he beheld a large red boulder. Selden saw that it was not iron ore, but when he told the Indians it was worthless they threatened to kill him, claiming he had not lived up to his agreement. Selden somehow managed to get back home none the worse for his experience, but without an iron-mine location to file on.

There are other stories of a different sort such as the one that involved a Menominee Indian named Wa-be-cat and a Doctor Hall of Marinette. When the Indian showed the doctor a piece of iron ore and agreed to disclose its source for the customary $100, the latter countered with an offer of $25, which the red man refused. According to the narrative handed down, Hall said: "If you'd tell me where there is a lot of good cork white pine, I'd be very much interested. Who wants any iron ore up the river? It can't float, and how in thunder are you going to get it out? I'm probably a fool, but I'll make it $50 and not a cent more. If you don't want that, take your ore and get out." The Indian left. It developed later that the ore came from the site of the present Vulcan Mine. The doctor had passed up a fortune.

Crystal Falls is the county seat of Iron County, though some still dispute its legal right to the title. Iron Ore-Rama included a skit showing the "stealing of the courthouse" from Iron River, an act that once threatened to cause bloodshed. In 1885, Marquette County was divided, and Iron County was born by legislative action. Iron River was designated as the temporary seat of government pending a general election. Crystal Falls wanted the honor, and its enterprising citizens set out to get it. Possibly they reasoned that possession is nine points of the law. At any rate, one wintry night they transferred the county seat to Crystal Falls, and it stayed there despite threats of violence and considerable political and legal maneuvering by Iron River residents.

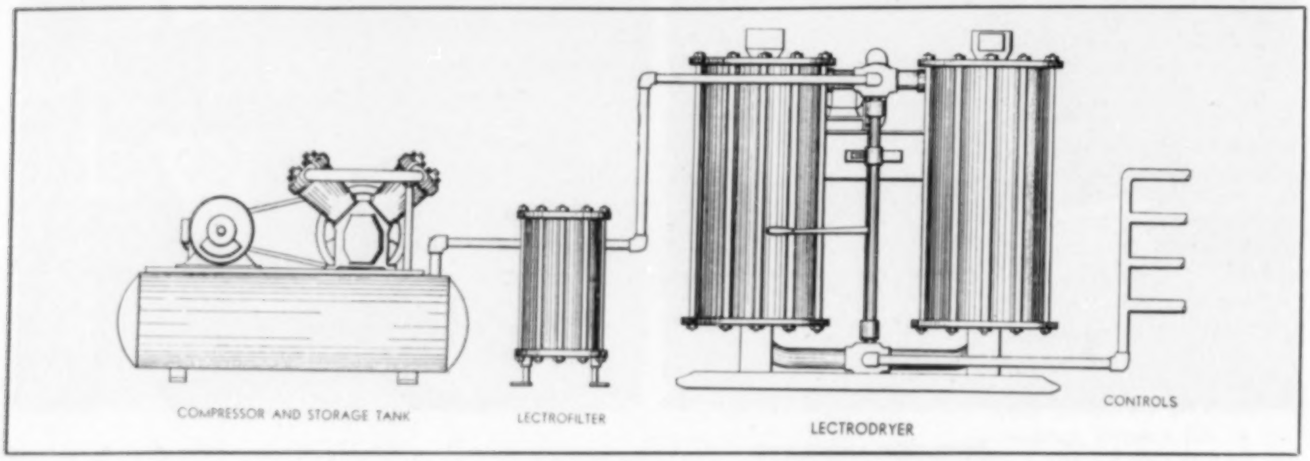
The fantastic piece of political larceny was engineered with the aid of a poker game. On a chosen date, Crystal Falls sportsmen started the game in the Boyington Hotel, in Iron River, a short distance from the frame building that contained the county records. They saw to it that stakes grew high, that liquor flowed freely and that all the inhabitants of Iron River got news of the big party. When the people had been lured to the game, and homes, business houses and streets were practically deserted, two Crystal Falls men excused themselves from the table and removed the records from the temporary courthouse. By sled and railroad the papers were transported to Crystal Falls, where the sheriff placed them under heavy guard.



CLOSE-UP OF A "HAULAGE DRIFT"

Simulating underground conditions as closely as possible, this haulage level was set up complete with tracks, cars, and electric-trolley locomotive. The overhead structure at the right end represents an opening to a stope with a chute at the bottom equipped with an air-operated gate by which the loading of ore into cars is controlled. In front of the "drift" are the miners who demonstrated the equipment

Alumina Used as a Dehumidifying Agent



DUAL SYSTEM

Schematic arrangement of an Electrodryer providing a continuous flow of dehumidified air to pneumatically operated controls. While one unit is in service the other is undergoing reactivation and cooling. Shifting from a spent to a fresh adsorber is done by moving a lever which actuates an interconnected and interlocking valve mechanism. Overheating of the alumina during reconditioning is prevented by means of a temperature-limit protective device. Each section is usually in service for a period of eight hours.

THE removal of that last bit of moisture from certain industrial fluids is often either essential or highly desirable. Aftercoolers, filters and separators have long been standard and indispensable equipment for extracting the bulk of the moisture entrained in gases. However, there are instances where any remaining trace should be withdrawn before the fluids undergo subsequent treatment or application. To take up where the bulk dehumidifiers leave off, the Pittsburgh Lectrodryer Corporation, among other manufacturers, has stepped into the field of water-vapor control and introduced its Lectrodryer equipment which is designed to bring dew points into line by means of the solid adsorption method.

High water vapor in gases is responsible for a host of troubles such as the formation of products of corrosion that clog piping and instruments, freezing of lines, and damage to chemicals and foods in process or in storage. These lead to inefficient operation and shutdowns, but can often be prevented by reducing the moisture content of the gases to a minimum. Lectrodryers have been designed for this purpose and are being utilized in the preparation of bottled gases that must be moisture free; in keeping moisture out of the atmosphere in which safety glass, radio and electronic tubes and drugs are produced; in providing a dry atmosphere for metal annealing operations; in supplying dry compressed air essential to the control of equipment in high-octane gas and synthetic-rubber plants, for unloading tank cars containing chemicals and for a long list of other industrial and laboratory uses.

Where nature, process or application cause undesirable moisture in organic liquids such as Freon, that serves as a refrigerant, and oil-industry's benzol, the new equipment can be brought into play because it works equally well in the adsorption drying of many liquids as it does in the field of gas dehumidification.

Alumina (aluminum oxide) is the solid adsorption agent used. There is an affinity between that substance and some gases at controlled temperatures which causes the latter to condense on the surface of the aluminum oxide. The corporation takes advantage of this phenomenon in its Lectrodryers, its Lectrobreathers which are designed for the purpose of preventing moisture from entering oil and chemical storage tanks, and in its Lectrofilters for the removal of oil vapor from compressed air and other industrial gases.

Another advantage of alumina is that it can be reactivated by the application of heat. This is done in various ways, depending upon the dryer used. There are three basic types: single, dual and multiadsorbers. The first is for intermittent service and is equipped with a blower and motor by which the moisture is extracted from the alumina at night or when the unit is idle. In the case of the twin type, one section provides a continuous flow of dehumidified air while the other is being reconditioned also by means of a motor-driven blower. The multidryer has beds of heating elements arranged so that drying and reactivation are accomplished simultaneously.

In addition to the standard type Lectrodryers, the company makes a 10x13x26-inch portable unit for laboratory use and special adsorbers in a wide range of sizes for pressures of 5000 psi and more capable of handling loads as high as 200 pounds of water a day. The little dryer operates at pressures as low as 2 inches of water but is built for pressures up to 15 psi.

Multiple Nut-Running Tools Economical

SINCE we worked up the article in our September issue on multiple nut-running tools, some interesting information on their low maintenance cost has come to us from one of the Detroit automobile plants. Two each of three types—a 5-tool combination for running nuts on wheel lugs, a 4-tool machine for placing nuts on U-bolts in spring-and-axle assemblies, and a 2-tool unit for running nuts on rear-spring shackle bolts—were put to work in the plant on November 11, 1950.

Up to the time of the report, neither the U-bolt nor the shackle-bolt machines required any maintenance; the only repair job necessary was the replacing of five vanes in the Multi-Vane driving motor of one of the wheel-lug machines. Under the previous arrangement, using individual tools on the operations, the average weekly maintenance cost was $6, which was also economical. However, the multiple-tool assemblies are said to have improved the quality of the work done.

All told, the machines in service contain 22 air motors, and it is considered remarkable that in nine months of operation only one had to have attention—a repair job that involved the renewal of but five vanes.

This and That

Mighty Small Tires

The tires that cushion the high-speed landings of the Douglas-built Navy rocket plane that lately broke speed and altitude records are no bigger than those on a Crosley automobile, but much stronger. The landing-wheel tires are capable of withstanding an impact load of 8 tons but are only 2 feet by 5½ inches in size; the nose wheel is 20 by 4.4 inches. They are made by The B.F. Goodrich Company, which reports that they carry about eight times as much pressure as automobile tires and twice that ordinarily in airplane tires.

* * *

Pumping Coal to Market

The idea of mixing finely divided coal with water and pumping it through a pipe line from mine to market was advanced more than 50 years ago but has never been tried on a large scale. Because of recent interest in the proposal, the U. S. Bureau of Mines has studied its possibilities and issued a report. It believes that a pipe line 100 miles long and large enough to transport 5000 tons of coal daily could be built for $10,000.000. The operating cost is estimated at from $1.28 to $1.91 a ton. A bigger line, capable of carrying 36,000 tons a day, would cost more but could, it is figured, move coal for from 38 to 95 cents per ton. The report admits that problems relative to pump performance and behavior of the water-coal mixture can be solved only by actual performance tests. Since the bureau's work was completed, a large coal company has announced that it is considering building a 12-inch line 17,000 feet long in Ohio.

* * *

Monorail Transit on Coast

The City of Los Angeles has received approval from the California Legislature to construct an overhead monorail railway. If built, it will be the second of its kind. The first one has been operating between the towns of Elberfeld and Barmen in the Ruhr district of Germany since 1901 and has carried millions of passengers annually without a fatal accident.

As planned, the Los Angeles system will run 44 miles from the San Fernando Valley, north of the city, to Long Beach, on its southern border. The route will generally follow the course of the Los Angeles River. Normally a dry stream, it has at times been swelled by floods, and as a control measure the bed and banks have been faced with concrete that might serve as foundations for the superstructure.

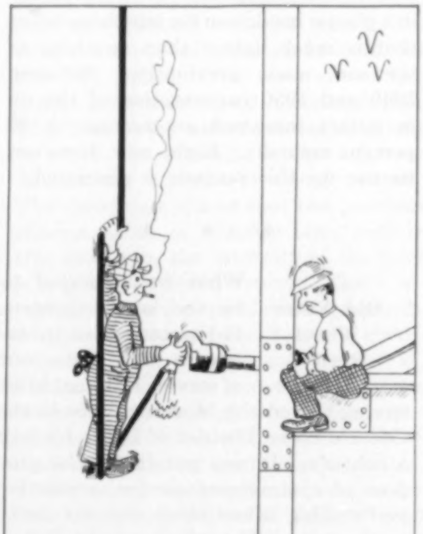
To provide for north and south traffic, two rails will be laid about 70 feet apart on inverted V-shaped steel supports. Electrically powered cars, with seats for 40 passengers and room for 60 standees, will run 16 feet above ground except at points where rises and dips are necessary to avoid bridges and other obstructions. Stations will be spaced at intervals averaging a mile.

A maximum speed of 55 miles per hour and an average speed of 38 miles are believed to be feasible. On this basis, a trip that now takes 100 minutes on surface trolley lines could be made in half an hour. The cost of constructing the monorail system is estimated at $1,500,000 a mile, as compared with $10,000,000 a mile for a subway.

* * *

"Come and Get It"

Industry is becoming food-conscious in its relations with the public. Several large firms now make a practice of serving a simple but satisfying meal to stockholders who attend annual meetings. Sometimes the guest list runs into the high hundreds. Last March, when the United States Steel Company broke ground near Morrisville, Pa., for the huge Fairless Works, it provided charcoal-broiled steaks and all the trimmings for the fortunate 700 or so who were invited to the affair. Service bordered on the alfresco, with only a gigantic circus tent between the diners and the threatening skies. A caterer brought all the equipment, food, and help to prepare the meal.



Fine as it was, this repast was perhaps exceeded in some respects by a luncheon recently tendered to 1200 guests at the opening of the Margam Works of the Steel Company of Wales. According to *The Iron and Coal Trades Review*, of London, this turned out to be "the biggest catering occasion outside London for a generation." It was thought for a time that the king would attend, and plans made with that in mind were not changed when it was learned that he would not be there.

The concern that had been engaged to do the catering shipped 20 carloads of paraphernalia and edibles a distance of 177 miles from its headquarters to Port Talbot, site of the mill. Arriving on a Sunday morning, they were unloaded by 40 porters and set up in a large building that was destined to house a rolling mill later on. A reception room, banquet hall, cloakroom, kitchen, and staff mess room were created and outfitted. On Tuesday the luncheon, preceded by cocktails, was served by 280 waitresses. They were directed by an executive of the catering firm from a box—something like a "pulpit"—from which steel-rolling operations will soon be supervised. The affair was so well organized that a 5-course meal was placed in front of the guests in just 55 minutes. The total staff involved in this culinary effort numbered 400.

* * *

Food Versus Coal

To bolster its lagging coal production, Great Britain has invaded farmlands and established open-pit workings. That move has not helped the food-supply situation. Farmers and land owners have decried the action, and the matter eventually reached the attention of the House of Commons. Following conferences, it was decided to restore land from which coal is stripped as soon as possible after mining operations have been concluded. Top soil removed from such tracts will be stockpiled so that it can be put back in place.

* * *

Facts on Air Cooling

Some history on the development of air conditioning has been published by Columbia University, which teaches the engineering fundamentals of this science to an increasing number of students. First off, Prof. Carl F. Kayan, who is the school's foremost authority on the subject, works in an unconditioned office. "The cobbler's children always lack shoes," he says. For that matter, there is more

"It looks all right, but will it last?"

air conditioning designed to aid industrial processes than to promote human comfort.

The pioneer effort in this country to make summer heat and humidity more bearable was put forward by A.S. Lyman of New York in the 1860's. He invented an "air purifier" which was incorporated in the headboard of a bed. It had no mechanical parts and depended upon some unexplained chemical action for its functioning. That was during Civil War times, and in promoting his brain child the inventor declared that it would enable one to be comfortable even in the warmest hospitals in the South. A feature of the apparatus was that the air could be scented with pine, balsam or other odor to the user's liking. Just what happened to the device is not recorded, but it is reported that Bellevue Hospital in New York bought two of them and wrote a glowing testimonial on their performance.

Cooling by means of ammonia refrigeration was begun in the 1880's, and one of the first applications was made by a British concern in a rajah's palace in India. The great growth in air conditioning came after the turn of the century. Among those who began to study the problem of controlling the amount of moisture in the air was Willis H. Carrier, then a young engineer with the Buffalo Forge Company. In 1903 he installed a system in a Brooklyn lithographing plant for regulating the water content of the atmosphere during the summer months.

During the next decade, pioneers in the industry devoted most of their attention to controlling humidity. That was followed by steps to maintain year-around uniformity of the atmosphere to improve and standardize various industrial processes. Comfort air conditioning did not become really important until the 1920's. For example, it was not until 1925 that the Rivoli Theatre, a movie house in New York City, put in equipment for this purpose at a cost of $65,000. The management was surprised but nonetheless delighted to find that the increased attendance paid for the installation in three months.

In some locations air conditioning contributes to safety. That is true in hospital operating rooms, for example. Years ago static electricity occasionally caused a patient, whose lungs were filled with an anesthetic, to explode like a hydrogen balloon. Protection against such an occurrence is now provided by controlling the humidity.

* * *

Castor Oil Boom

Castor oil which finds its greatest use in industry, contrary to what little girls and boys believe, is perhaps going to be one of the major crops in the Southwest. The oil is extracted from the bean which, in recent years, has come chiefly from Brazil. The plant is a large one, growing to heights of 10 to 20 feet, and the seeds have to be picked by hand. However, a smaller bush has been developed that will permit machine harvesting.

Approximately 60,000 acres were planted this year in California, Arizona, Texas, and Oklahoma, and a yield of beans worth $9,000,000 is expected. The Massey-Harris Company has designed a machine that sells for $4500 but will do the work of from 50 to 100 hand pickers. Fifty were supplied for service this year.

Castor oil is in demand as a lubricant for airplane engines and as an ingredient in a plastic insulation for telephone wires that is much lighter than anything of the sort made previously. Between 1940 and 1950 consumption of the oil in paints increased an average of 50 percent annually. Right now, however, its use for this purpose is restricted.

* * *

Old Water Wheel Retired

What was reported to be the largest tangential water wheel in existence was taken out of service last year after having served the Morning Mine in the Coeur d'Alene District of Idaho for half a century. It was put in for the purpose of compressing air for ventilation and drilling before there was electricity in the area. The wheel, of the Pelton type, was 33 feet in diameter and mounted with two 12-foot auxiliary wheels on a steel shaft 15½ inches in diameter and 33 feet long. It is said that the shaft had been forged for the driving mechanism of a battleship.

The plant was located about 3 miles from the mine. Two water jets, operating under heads of 1000 and 1400 feet and obtaining their supplies from creeks, hit the buckets on the rim of the big wheel with terrific force, turning it at a maximum peripheral speed of about 90 miles an hour. Three jets, with the comparatively low head of 140 feet, played on the smaller wheels. Compressors located at both ends of the horizontal shaft had a combined capacity of 5000 cfm.

Because the water supply was variable, a 3000-cfm and a 2000-cfm motor-driven compressor were installed within a few years to take over during dry seasons. In 1939, two 300-hp motors were connected with the shaft in such a way that they would idle when there was ample water to keep the compressors at capacity, or pick up whatever share of the load was necessary to maintain capacity. The air was delivered to the mine through a pipe line 13-inches long.

Last year the shaft cracked through at a point between the Pelton wheel and one of the smaller units and it was necessary to remove the section on which the large wheel was mounted. Inquiries were made about a replacement shaft, but it developed that it would require so much time to procure and put in service that the move was impractical For that matter, the hydraulic installation probably had been costing the mine money for some time, according to an account in *News Letter* published by American Smelting & Refining Company, which owns the Morning Mine.

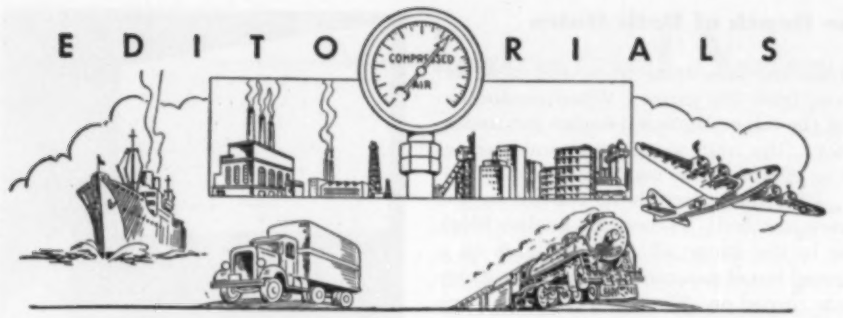
"Though a mechanical marvel of its day," the article reads, "the big wheel had outlived its usefulness. A check-up of power records over the past seven years revealed that only during seven months had the water power been adequate to carry the entire load for the 5000-cfm unit. Reports of current power consumption indicate that during low-water periods the world-famed installation may have been a drag on the line.

HANK ROESLER

COURTESY WHEELCO INSTRUMENTS COMPANY

"When you getting your new glasses, Jimson? You're reading that crack in the wall again."

EDITORIALS



CROPS FROM THE SEA

IT IS remarkable the way the land and the sea team up to minister to mankind's wants. The land provides wood, stone, and metals with which to build homes to live in, factories and offices to work in, railroads and highways to travel on, and even coffins to be buried in. The soil also yields coal to ward off the winter chill, and water to drink. All these and more are to be had practically for the taking; but the land, unaided, brings forth only a limited supply of things that man can eat.

It is true that there are berries and fruits, especially in the tropical areas, and wild fowl and animals; but the latter do not perpetuate themselves in sufficient numbers to meet the demands of the earth's swelling population. When the Indians had North America to themselves there were enough bison and wild turkeys to go around, but it was not many years after the coming of the white man that they were threatened with extinction. So far as field crops are concerned, there are few edibles that will grow abundantly unless they are planted, fertilized, and cultivated.

The sea, however, fortunately supplements the bounty of the land and makes up for its shortcomings. Except in the case of oysters and lobsters, man does little to aid Nature in providing sea food, yet there is seldom a shortage. Roughly, seven-tenths of the earth's surface is salt water, and experts say that, on the average, an acre of ocean is twice as productive of plant and animal life as an acre of land. There always seems to be enough fish no matter what the demand may be, although there is, at times, a scarcity of certain varieties. To get them it is necessary only to send out more fishermen. For that reason the price of sea food has risen relatively little in comparison with that of red meat, despite the great growth in fish consumption resulting from canning and freezing. There was a time when little fish was available except along seacoasts; now it is processed in many ways and kept in good condition for a week or a year after it has been caught.

The sea not only helps materially to feed us but it is also contributing an increasing proportion of our supply of numerous inorganic products. Mineralogically speaking, the ocean contains a little of everything that washes off the land. Most minerals are soluble to some extent in sea water and are consequently to be found there, even though the concentration in many instances is extremely low. Still, minerals are present, and more of them are being carried into the seas as time goes by, accumulating against the day when they will be needed. Magnesium and bromine are already being economically extracted from the ocean, and many other elements will join the list as land sources are depleted.

●

GEOCHEMICAL PROSPECTING

GEOLOGISTS are of the opinion that most of the major ore deposits in the United States that extend to the surface of the ground have been discovered. Still unfound, they believe, are many that are hidden from a few feet to hundreds of feet underground. Locating them is, of course, a difficult matter at best, but techniques recently developed by the U. S. Geological Survey promise to help materially.

Involving both geology and chemistry, the new discovery methods are called geochemical prospecting and consist in making extremely sensitive tests in the field for traces of minerals in both the soil and plants. The tests are of two kinds, colorimetric and chromographic. The first makes use of colored solutions in which the intensity of the color indicates the amount of metal present. The chromographic or spot test provides colored spots of definite size, and in this case, too, the intensity of the color is a guide to metal concentration.

A new instrument, the chromograph, designed by two of the Survey's chemists, Rollin E. Stevens and Hubert W. Lakin, enables an analyst to produce colored spots on a piece of filter paper that are compared with standard spots made with known quantities of metals. These comparisons make it possible for him to detect with the unaided eye minute amounts of minerals occurring in soils, rocks, and plants.

The equipment and chemicals used are inexpensive and easily transported. The processes are simple and require little time for their execution. By their aid prospectors can quickly get information without leaving the field, whereas samples must be sent away when conventional assaying is relied upon.

Up to date the chromograph has been utilized to make quantitative spot tests for determining the presence of cobalt, nickel, copper, and silver in soils and rocks and of nickel in vegetation. Silver is important not only for itself but because it is associated with many other metals, any or all of which may exist where it is found. A satisfactory test can be obtained if as little as a gram of material is at hand, and the chromograph will produce a spot if the silver content is but one part in five million.

The colorimetric method indicates the presence of minerals in water samples from springs, streams or lakes. The chemical dithizone is mixed with carbon tetrachloride in a tube, some of the water is added, and the mixture shaken vigorously. Upon settling, the tetrachloride collects at the bottom of the tube and above it is the dithizone, which is normally green but is turned red by metals. The final color of the mixture is a combination of green from unreacted dithizone and red metal dithizonates. The test is so sensitive that it will reveal as little as 0.002 part per million of zinc and 0.01 ppm of lead or copper. Minerals in soils or rocks can be similarly detected by first digesting some of the material in acid.

To determine the efficacy of these techniques, they have been thoroughly tested on known ore deposits as well as in areas devoid of mineralization. In one of the latter sections a definite reaction for lead was obtained, and drilling proved the presence of a vein from which some 10,000 tons of ore has so far been mined.

Elements vary a good deal in their geochemical habits. Lead, for example, seldom produces a reaction except close to where it lies, although zinc is perceptible at appreciable distances. In general, there is a considerable area around heavy ore concentrations in which evidence of their presence can be detected. These areas are oval shaped and called "haloes." They may be either primary (originating from the dispersion of metals in rocks when the ore bodies were formed) or secondary (formed by the dispersion of metals during the weathering processes.) The first type is confined mainly to bedrock, while the second is found in soils, plants and ground water. Primary haloes will follow steep fracture zones, and some have been observed that emanated from ore lying 500 to 700 feet below the surface.

Chromographs will be manufactured soon and will be available to the general public. The instrument has been called the "poor man's spectograph" because it gives anyone the means of making determinations that have long been obtainable only by spectographic analyses.

Pneumatic Fingers Probe Depth of Drill Holes

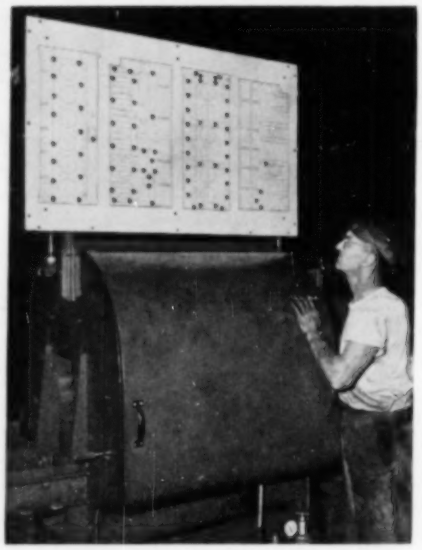
AN automatic gauge combining the use of compressed air and electricity to check the depth of drilled holes in engine blocks is another excellent example of what can be accomplished when American industry is faced with a manufacturing problem. The gauge is a valuable adjunct in the Indianapolis, Ind., truck-engine plant of the International Harvester Company and is a local affair in thought, design and construction.

Back in 1947, when plans were being made to retool the sections of the plant in which the new Silver Diamond engine was to be built as a part of International's new L-line truck models, it was decided that the machining lines for the engine block and head should be in the form of a series of transfer machines. It was reasoned that such machines, performing the multiple operations involved in automatic cycles, would result in higher than normal production for any given period but that their installation would create difficulties if certain nonmachining operations were to keep pace with production.

One of these problems in the case of the engine-block machining line concerned the checking of every drilled hole for proper depth before tapping, work that would have to be done to avoid breaking taps or ruining spindles in case some of the holes were not deep enough. A. M. Bowers, works manager, had an idea for a method by which the necessary checking could be done on an automatic basis. He suggested a large tunnel-type gauge that would be set in the conveyor and check all holes at one time. The plant's mechanical engineering department, headed by Joe Olender, took the idea from there and designed and built the gauge. When production of the Silver Diamond engine got underway, the unit was an integral part of the engine-block machining line.

Checking proceeds as follows by the new method: When an engine block is in the gauge all the red lights on a panel board mounted on top of the gauge are turned on. There are 78 lamps, each of which indicates a specific hole drilled in the block. Then the operator pushes a button switch, thus causing a like number of gauging fingers to enter all the holes simultaneously. The fingers are actuated by means of small pneumatic cylinders, which are connected to limit switches that control the lights. When compressed air is admitted into the cylinders, the pistons move the fingers forward, and if a hole has been drilled to the proper depth its lamp goes out. But if one or more of the red lights continue to burn, their location on the panel board quickly identifies the hole or holes that need further drilling before they are ready for tapping.

Like any new-type machine, there were "bugs" in the gauge that had to be worked out. That has been accomplished, and the unit has proved itself to be a practical solution of a tough problem—how to do the job of checking drilled holes fast and automatically and without damage to taps and spindles.



THE BIG GAUGE

Protected by a metal housing, the gauge is an integral part of the engine-block machining line and operates automatically. Mounted on top of it is the panel with its 78 indicating lights. Those that continue to burn while checking is in progress identify the holes in the engine block that are not drilled deep enough.

Desurger for Pipe Lines

WATER hammer in oil pipe lines is virtually eliminated, it is claimed, by a desurger made by the Valve Engineering & Development Company. The unit is of through-flow design and accumulates the shock pressure waves, dampens their energy, and sends them on without the damaging pulsations. Interposed in the fluid line, it consists of a pipe with a series of throttling orifices and of a larger surrounding pipe. The annular space is divided longitudinally by a membrane or sleeve made of Hycar American rubber, and the outer chamber is charged with air or gas to counterbalance the nominal pressure in the fluid line.

The action of the Fluidynamic Desurger, as it is named, is as follows: In the case of excess head caused by the action of the pumps or by the closing of a valve during oil-well drilling operations, the liquid is robbed of some of its energy by flowing through the throttling orifices into the annular chamber, where it is forced against the membrane, causing the latter to expand and to compress the gas on the other side of it. This further dampens the pulsations and expels the liquid back into the fluid line, giving the orifices another chance to absorb harmful energy.

In an installation designed for mud-pumping operations, hydraulic shock was reduced, according to reports, from 950-2250 psi to 1850-1900 psi, which represents a surge removal of 96 percent. In this connection it should be mentioned that the unit could not have functioned economically without the use of the Hycar membrane, an abrasion- and corrosion-resistant product made by the B.F. Goodrich Chemical Company.

IN OPERATING POSITION

The large pipe in the foreground is the desurger interposed in the mud line of a rotary drilling rig in a Gulf Coast oil field.

Industrial Notes

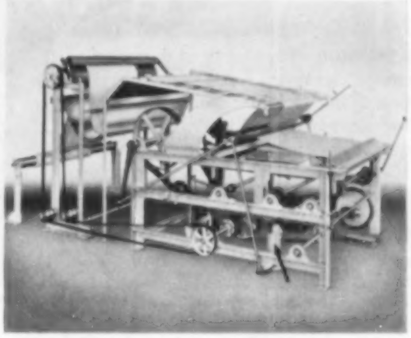
High production of good quality with minimum operator fatigue were the objectives sought by the Motor Division of the Arnolt Corporation when it designed its pneumatically controlled upholstery press. The machine is of steel construction with an aluminum bed over which a rubber diaphragm $\frac{1}{8}$-inch thick is stretched. On this cushion is placed the upholstery material, outer surface down, the padding, and the back or seat panel to which the fabric is to be fastened. During this operation the assembly is held in place and compressed between the rubber diaphragm and a frame that conforms in shape to the assembly. Pressure is exerted by an air cylinder operated by a hand lever and is regulated by an air gauge at from 70 to 90 psi, depending upon the type of the work. For a flat, tight seat, for example, the pressure should be around 70 psi, while 40 psi suffices for one with a high, soft crown. The press bed rotates easily on ball bearings so operator does not have to change his position during tacking or stapling.

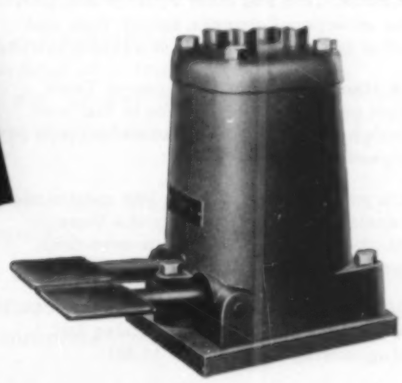
Want a quiet place in which to work? Then coat ceiling and walls with Gold Bond Thermacoustic—a material that is said to absorb sound, to fireproof and to insulate at the same time. It can be sprayed on masonry, plaster, metal and glass by an air gun and may be applied so thin as to preserve any ceiling design or to a thickness that hides unsightly piping. It can also be painted without appreciable acoustical loss. Thermacoustic is a product of the National Gypsum Company, and there are six kinds to meet varying needs.

What is claimed to be a revolutionary method of soldering has been developed by McCord Corporation in cooperation with Mathieson Chemical Corporation. Known as the Coronil Soldering Process, it is based on a new series of fluxes which bear the trade name M.C.C. and are made from hydrazine, a Mathieson chemical. The fluxes are said to be suitable for use in joining most metals and to produce bonds of exceptionally high strength without leaving corrosive residues. Obtainable from Mathieson, they are to be used in all the McCord plants, in one of which they have received a thorough tryout.

Mechanical equipment is coming to the aid of the janitor by enabling him to wash up to 5000 square feet of wall surface or ceiling in a day. The equipment with which he can do this consists of two aluminum tanks each with a 16-foot hose connection ending in a trowel with a washable scrubbing pad. One tank contains a cleaning solution and the other rinse water, which are applied by compressed air. Buttons on the trowels control the flow and prevent dripping and splashing.

Air-operated jaws and an automatic lift-and-drop table are features of a new cloth-folding machine designed and built by Hall & Jansson Company. The two clamps, which extend the width of the table, are operated by a foot-controlled pneumatic cylinder, the piston of which exerts an upward thrust against a loosely pivoted rocker bar. The pressure thus applied is successively transferred to lifter arms pinned to rock shafts at the ends of the bar and to links attached to the jaws. The latter are opened alternately by means of cams which rotate the rock shafts, so that first one clamp and then the other holds the material as folding proceeds. If the fabric is to be cut at any point during the operation, or when the end of a piece is reached, pressure in the cylinder (indicated by an arrow in the illustration) is released by the 3-way foot valve, causing both jaws





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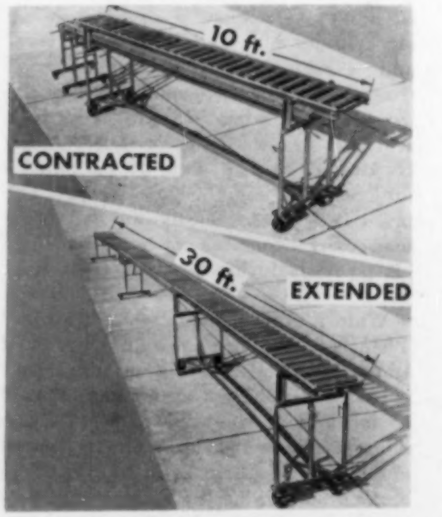
to open. As the exhaust usually occurs only every minute or so, little air is consumed. Pressures used vary from 35 to 45 psi, and a 3-inch-diameter cylinder has a lifting capacity of 250-300 psi. The machines are constructed to meet textile-mill requirements, but with a little adjustment will handle any kind of cloth ranging from nylon, silk, rayon and cotton to seersuckers, plisses and bulky fabrics, even some plastics and many paper products. A counter may be attached to register yardage handled. This device is provided with a stop that causes it to idle when the folder is not running. The repetitive movement of the table from low to starting position is effected by reduction-gear motor drive.

Toughness is the outstanding quality of Kodagraph Autopositive Paper, a new product made by Eastman Kodak Company for reproducing drawings. It is claimed that rough handling won't tear it and that blue- and direct-process prints can be turned out up to 30 percent faster with it than with the less translucent standard paper.

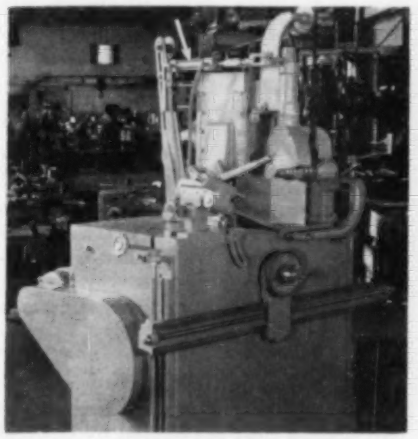
Through the development of an air-operated piston-type shift or grinding-wheel head member, the Hanchett Manufacturing Company has been able to redesign its sharpener for heavy-duty circular saws and eliminate 25 moving parts, according to a recent announcement. As a result of this improvement, the machine is said to run smoother than the earlier model, to be easier to



PORTABLE CONVEYOR

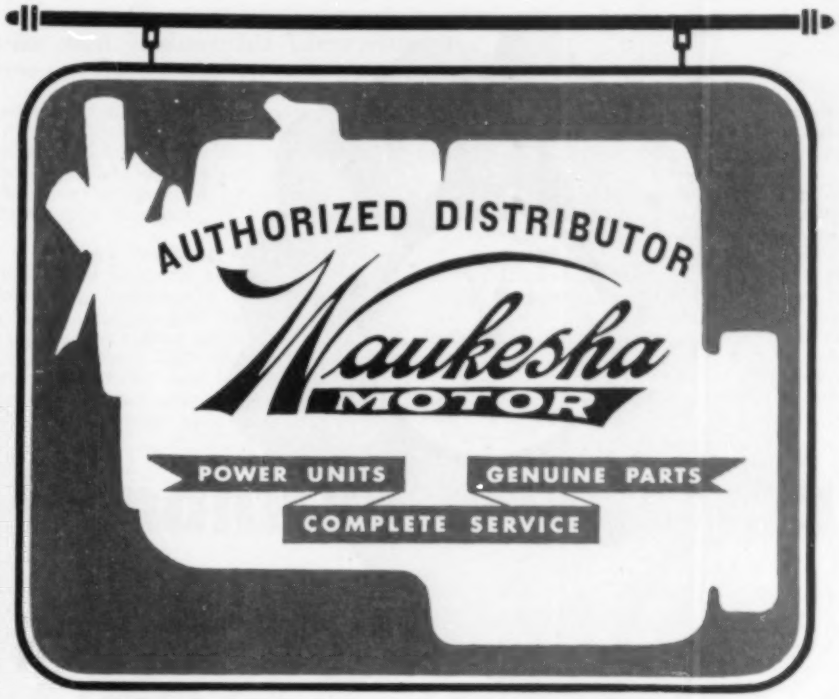
Mounted on casters and made to telescope, this all-steel conveyor saves time and labor in moving heavy loads short distances anywhere in or outside of a plant where its service might be required. Bundles or parts that do not have flat bottoms can be carried. The conveyor is manufactured by The Wilkie Company in 12- and 18-inch widths and nine different lengths that are extensible to a maximum of 30 feet.

adjust, and to operate with greater accuracy. Suitable for saws from 20 to 72 inches in diameter, the No. 772 can sharpen all kinds of circular saws used in pulp and paper mills and for forest products generally; rip, trimmer, slasher and edger saws with and without collars; as well as solid- and inserted-point log-cutting saws. Hundreds of different types of teeth, spaced from ⅜ inch to 3 inches apart, may be ground by the aid of interchangeable tooth cams, and adjustment for bevel from 0 to 45° in each direction can be made. The pneumatic cylinder (indicated by an arrow in the accompanying picture) controls the oscillations of the grinding wheel and returns the head to its exact starting position at the end of each operating cycle. The machine is driven by a 2-hp motor and, under normal conditions, uses air at from 20 to 25 psi.



In a 2-story recess atop Pittsburgh's newest and largest skyscraper is a 97-foot cooling tower which is part of a multimillion-dollar heating, ventilating and air-conditioning system designed by Dravo Corporation engineers for the 41-story building to be occupied by U. S. Steel Company and Mellon National Bank & Trust Company. An idea of the scope of the project can be gained from a few statistics. Some 16 miles of copper tubing and 13½ miles of steel pipe ranging in diameter from ¼ inch to 24 inches are needed to carry steam, condensate, hot water, chilled water, drainage and compressed air. The cooling capacity of the refrigeration equipment is equivalent to the melting effect of more than five million pounds of ice daily, and fans with a total capacity of 528,000 cfm will circulate the air in the structure. About 50 million pounds of steam will be used annually.

A handy soldering-brazing torch suitable for production or job work is being offered by Mass Company. It can be operated with natural, artificial or bottled gas and may be breath-blown or attached to an air compressor. The



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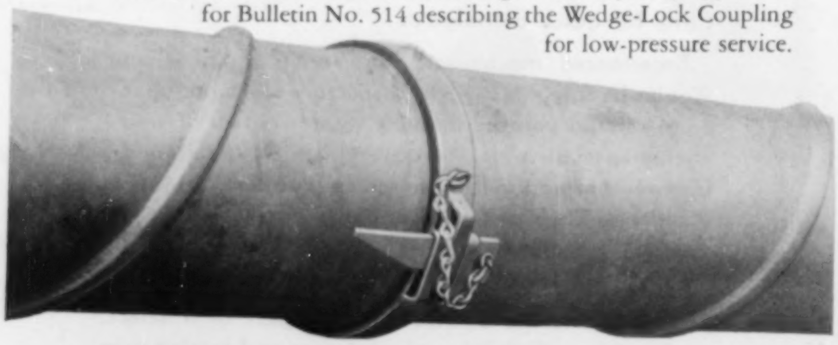

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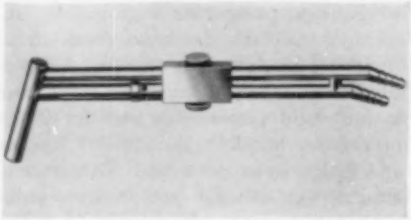
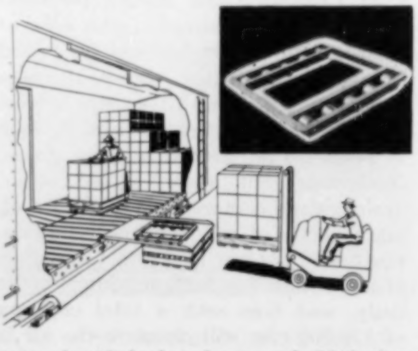


volume of the gas and air is regulated by thumb control to give anywhere from a needle-point to a pencil-size flame, producing heat up to 2500°F. The torch is made of brass tubing, is 11½ inches long, and weighs about 10 ounces. It is recommended for radiator, electrical and sheet-metal work, as well as for silver soldering, light brazing and for hardening drills and drill bushings.

According to *Du Pont Magazine*, rock drills and pneumatic tools are served by approximately 25,000 miles of air hose, enough to girdle the earth at the equator. Around 8000 miles is manufactured for the purpose every year of both natural rubber and synthetics such as neoprene.

Reusable sweatbands to keep perspiration out of workers' eyes and spectacles and goggles clear are offered by General Scientific Equipment Company, Philadelphia 32, Pa. They are made of cotton-backed gauze that is expanded to about eight times its normal thickness to promote absorption.

Loading and unloading reefer cars (cars with slatted decks) by the aid of pallets is greatly facilitated, it is reported, by a pallet roller designed by the Frank L. Robinson Company. As the illustration shows, it features ten large-diameter rolls that have ball bearings at each end and are prevented from turning in the frame by hexagon axles keyed by cotter pins. The standard type is 42 inches long and 36 inches wide and has a carrying capacity of 4000 pounds. The Ace Reefer Pallet Roller is used in connection with a bridge ramp placed in a level position between the deck of a car and a loading dock. Of the tilt type, its high-set center rolls permit quick change in direction and full 360° movement.



You've heard of die-pressed forgings but possibly you don't know all that may be expected of them. The American Brass Company, Dept. DPF, Waterbury 20, Conn., will send you upon request the third edition of Publication B-9 which is a handy reference book on copper and copper-alloy die-pressed forgings.

Why Engineer an Industrial Floor? That is the title of a 12-page illustrated catalogue distributed by Flash-Stone Company, Inc., Philadelphia 44, Pa. The booklet illustrates the loss in operating efficiency, the safety hazards, and other detriments attributable to unengineered floors in industrial plants and tells how the ills can be corrected.

In a new catalogue recently published, W. H. Nicholson & Company, 12 Oregon Street, Wilkes-Barre, Pa., describes its complete line of steam, air, and gasoline traps and steam, air and gas separators of different types. Included are capacity tables, installation diagrams, and a section containing data, charts and formulae for determining the right size of trap for a specific application. In writing ask for Catalogue No. 751.

An electromagnet combining compactness, adaptability and a field strength of more than 40,000 gauss with an input of only 20 kw should be of interest to laboratory workers. A paper by Prof. Francis Bitter and F. Everett Reed reviews the development of this improved iron-core magnet and can be obtained by writing to Herbert H. Howell, Mechanical Division, Arthur D. Little, Inc., 30 Memorial Drive, Cambridge 42, Mass.

A pocket-size calculator for determining the weight of sheet metal—steel, aluminum, iron, copper, bronze or lead sheets—is offered by Dayton Rogers Manufacturing Company, 2824 13th Avenue South, Minneapolis 7, Minn. Calculator is made of celluloid and easy to use. Merely set the thickness opposite the width, and the weight will be opposite the length. The calculator can be obtained free of charge by writing on a company letterhead.

Ace Drill Bushing Company has taken the 3023 different symbols representing drill bushings produced by leading manufacturers and has catalogued them according to A.S.A. standard bushing sizes. This is apparently the first attempt by anyone to standardize the arbitrary symbols and to incorporate them in a handy conversion table. The company, located at 5401 Fountain Avenue, Los Angeles 29, Calif., is offering copies of these tables without charge as a public service.

Mack Trucks, Inc., 350 Fifth Avenue, New York City, is distributing a highly informative 4-page leaflet prepared by its Trucking Information Service on the importance of trucking to our national economy and our individual well-being. In it are presented facts to gain support for a program (1) to secure high priority for the needs of our essential roads, (2) to abolish obsolete and conflicting state road restrictions and (3) to gain full use of highway taxes for better highways.

Bausch & Lomb has produced a new line of laboratory microscopes called Dynoptic Laboscopes featuring high precision. Final adjustments of focus are made by the operator in a relaxed and comfortable posture by means of a low-positioned control. Several other improvements are incorporated in the new line, which is fully described and illustrated in Catalogue D-185 that can be obtained by writing to the company at Rochester, N. Y.

Tolerances allowable in today's industrial world preclude all but the best of measuring instruments and it would be severely handicapped without precision gauges of the highest caliber. The Republic Gage Company, 2228 Fenkell Avenue, Detroit 21, Mich., has long manufactured precision thread, plug and ring gauges and has recently gone to great pains in preparing for its customers, dealers and agents a comprehensive and well-illustrated catalogue—No. 51—on its products.

A Few Facts About Dehumidification for Industry put out by the Abbeon Supply Company, 179-15 Jamaica Avenue, Jamaica, N. Y., contains information on the subject that is not generally available. It deals with relative humidity and how it is computed; the signs and results of too much humidity; different methods used to remove moisture from the air; and humidities recommended for various industries. This 1951 edition of the company's bulletin is obtainable upon request.

Donaldson brings you

Longer Engine Life
on a
tray...

BALANCED DISTRIBUTION of oil across the entire lower element, eliminates both "overloaded" and "thin" areas.

Extra-heavy-duty Donaldson Air Cleaners now hold a series of conical wire-mesh-screen "trays" in the scrubbing area. This design feeds more of the condensed oil back into the air stream as it leaves the center tube. The result, proved in five years of laboratory and field tests, is higher cleaning efficiency and greater dirt-holding capacity. Only Donaldson has this new "tray-type" cleaner. We invite manufacturers to write or call for design data and test reports.

DONALDSON COMPANY, INC.
666 PELHAM BLVD. • ST. PAUL 4, MINN.

Donaldson AIR CLEANERS

Protect Air-operated Equipment Against Moisture and Dirt

The positive way to remove moisture and dirt from compressed air lines is to use the Cuno MICRO-KLEAN Air Line Filter.

This unique cartridge-type filter removes all entrained moisture, plus all foreign particles (dirt, pipe scale and other trash) down to 1 micron in size.

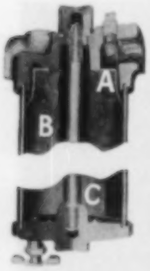
The dry, clean air assures more satisfactory performance—and longer life—of pneumatic tools, instruments, paint spray systems, hoists, etc.

Less Work for You

The Cuno MICRO-KLEAN Air Line Filter does its work with less attention required from you because its cartridge needs replacement only half as often.

The resin-impregnated fibres are non-wicking, so the trapped moisture drains promptly. The extra-large moisture-collecting area means less frequent draining.

Pressure drop across the cartridge is slight due to the openness of the structure—80 to 90% porosity—and to the absence of purely structural components (none needed) that offer resistance to flow.

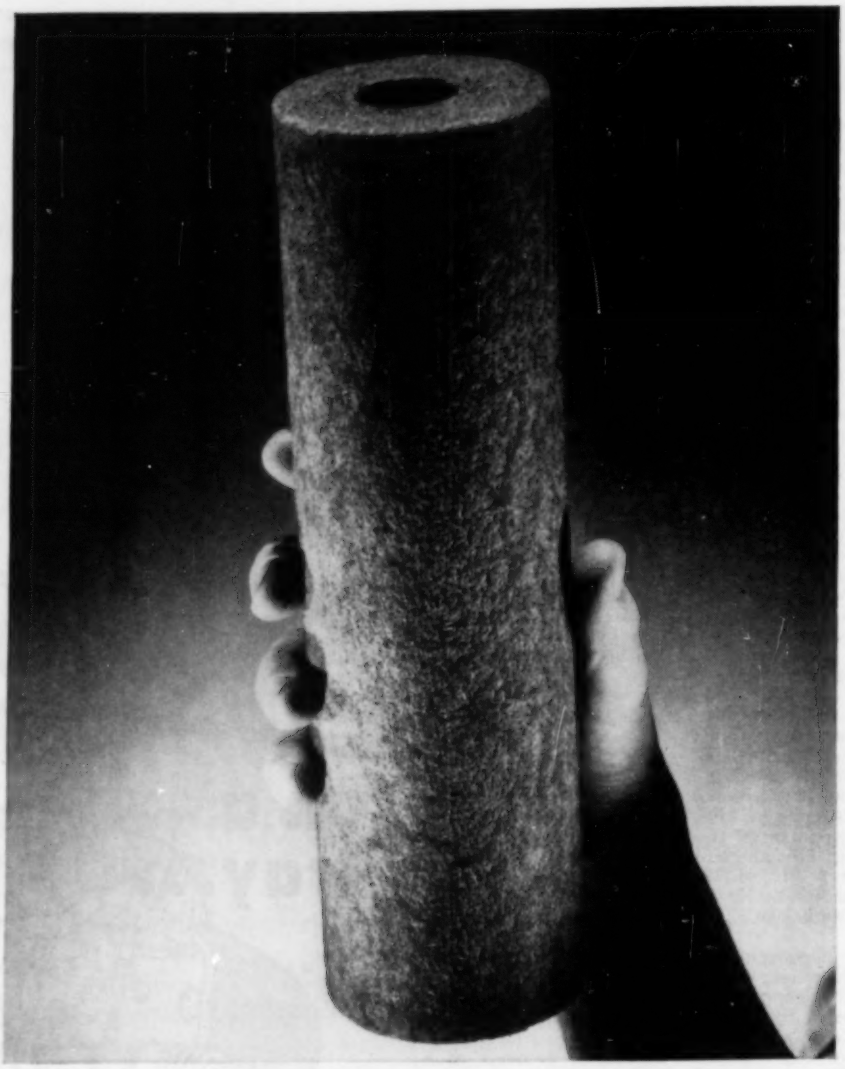


A. Baffle deflects some moisture down outside cartridge.

B. Network of fibres catches remaining moisture and dirt as air works its way through interstices.

C. Trapped moisture drains into collection chamber.

Cuno Engineering Corporation
Dept. 177C, South Vine Street, Meriden, Conn.
Please send information on Cuno MICRO-KLEAN
Air Line Filter for ....
Name....................Title........
Company............................
Address.............................
City................Zone....State....
Please attach to your business letterhead



The Simplest Filter Cartridge Lasts the Longest...Twice as Long

Cartridge renewals are cut at least *in half* when Cuno MICRO-KLEAN replaces any other filter. And throughout its service life, MICRO-KLEAN is *guaranteed* for specific performance.

CUNO

Fluid Conditioning

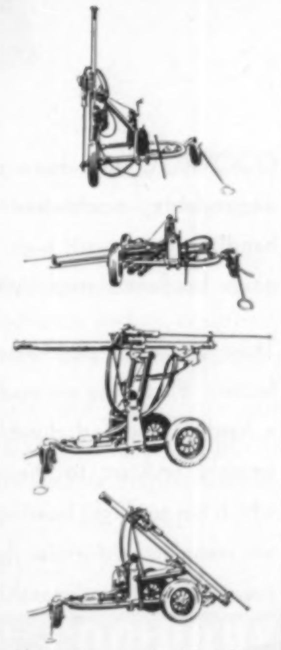
Removes More Sizes of Solids from More Kinds of Fluids

Strain fuels, lubricants, process fluids, etc.—AUTO-KLEAN
Filter fuels, lubricants, process fluids, etc.—MICRO-KLEAN
Clean raw water, recirculating water, etc.—FLO-KLEAN

3 Reasons Why You Get *Faster*, *Easier* Drilling

ALL ALONG THE LINE

Permits Easy Drilling in Any Position



Ideal when used with I-R's new 600 cfm Gyro-flow Portable Compressor

with the NEW FM-3 WAGON DRILL

1. **MAXIMUM DRILLING POWER.** The heavy duty X-71WD Rock Drill is the only drill made especially for Wagon Drill Service. Its drilling speed and hole cleaning ability are recognized wherever Wagon Drills are used. It has the power and stamina that mean extra long life, even on the toughest jobs.
2. **UNLIMITED VERSATILITY.** The new FM-3 Wagon Drill Mounting features an improved lifting mechanism and rugged yoke, designed to permit fast, easy drilling in any desired position—for line holes, toe holes, horizontal holes along a face, or angle drilling in floor or face.
3. **MINIMUM SET-UP TIME.** A powerful worm gear mechanism raises the yoke and drill guide quickly and easily, at the turn of a crank. Angular position of the drill guide is adjusted by a quick-acting universal cone-type clamp.

When fast-drilling, longer-lasting Carset Jackbits are used with the FM-3 Wagon Drill, you've got a drilling team that's unequaled for speed, efficiency, and economy of manpower.

Remember, Ingersoll-Rand's complete line of rock drilling equipment is sold and serviced by men who are skilled specialists in the field. Write or phone your nearest I-R representative for further information.

CARSET JACKBIT

SET WITH CARBOLOY INSERTS

manufactured exclusively by

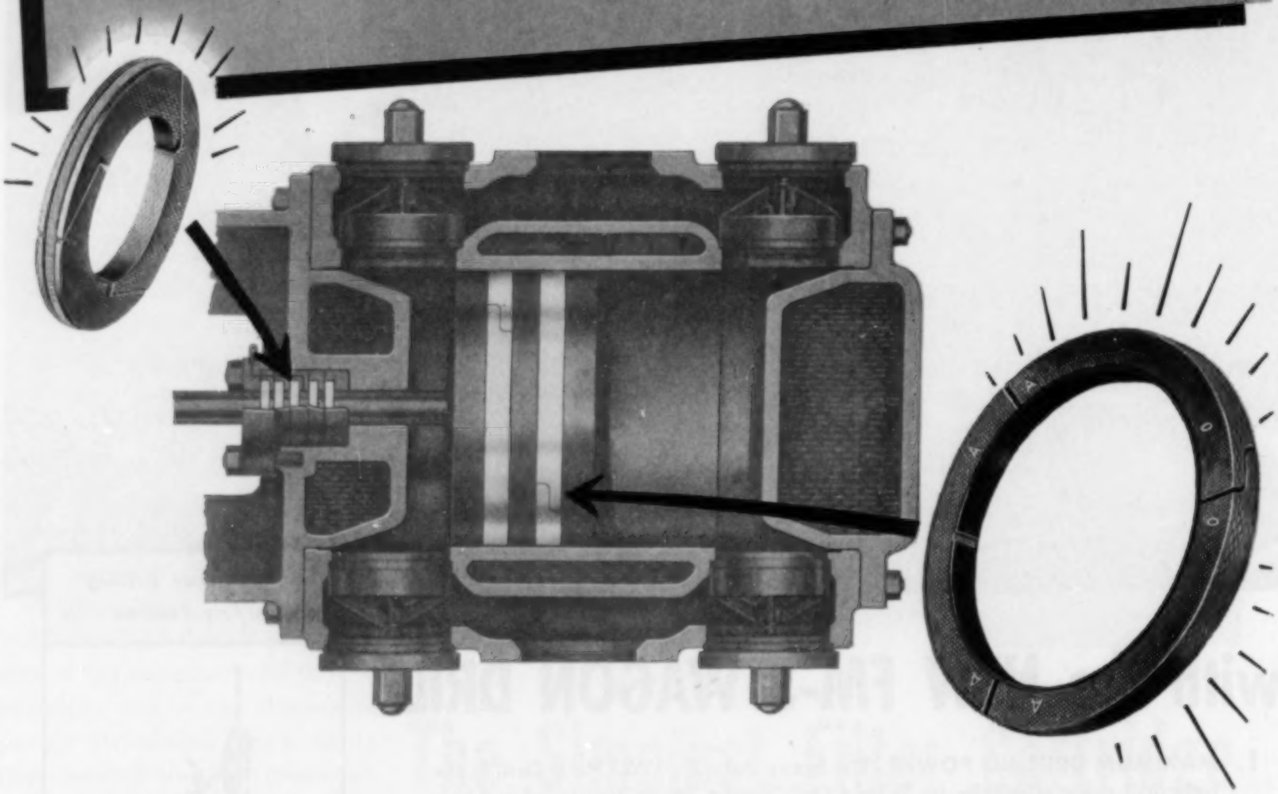
Ingersoll-Rand

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

689-5

Corrosive gas conditions call for COOKROC Packing and Piston Rings



COOKROC rings have established a record for dependable, troublefree service in compressors handling gases with high H_2S concentrations and gases burdened with hydrocarbon vapors.

Their successful performance is due to two basic factors. First, they are made of Laminated Bakelite, a hard, dense and durable material which is extremely resistant to the attack of corrosion and which has topflight bearing qualities. Second, they are manufactured under the same high standards of precision and workmanship that have made Cook Metallic Packings and Piston Rings the choice of compressor operators and builders the world over.

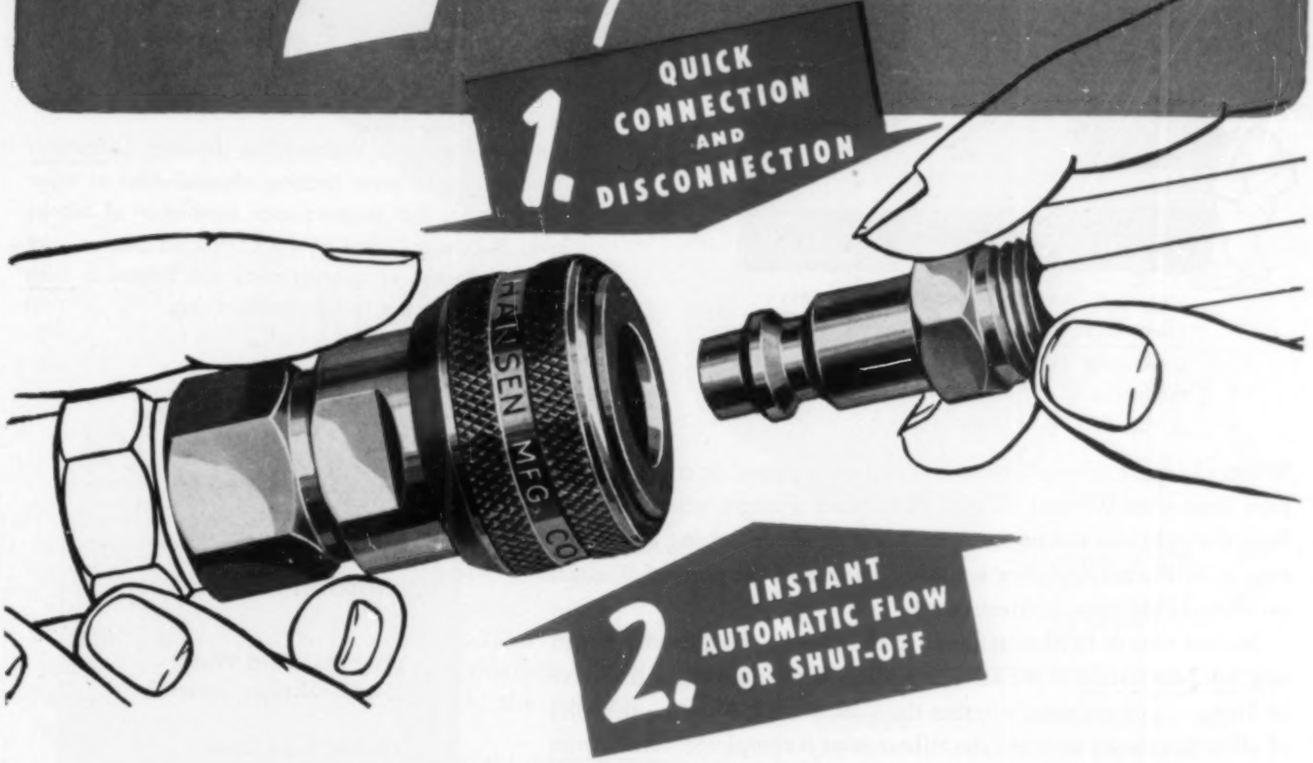
COOKROC rings are available in Standard, Graphitized and High-Temp materials and in many styles to fit existing grooves in packings and pistons. For complete information, write today.

C. Lee Cook Mfg. Co., Incorporated, Louisville, Ky. Branch offices in Baltimore, Boston, Chicago, Cleveland, Houston, Los Angeles, Mobile, New Orleans, New York, San Francisco and Tulsa.

. . . SEALING PRESSURES SINCE 1888 . . .

HANSEN COUPLINGS

GIVE YOU 2 Big Advantages



1. QUICK CONNECTION AND DISCONNECTION
HANSEN MFG. CO
2. INSTANT AUTOMATIC FLOW OR SHUT-OFF

WRITE FOR CATALOG

QUICK-CONNECTIVE COUPLINGS for AIR
ACETYLENE • OIL • GREASES • GASES
VACUUM • STEAM • OXYGEN • HYDRAULIC

REPRESENTATIVES

BALTIMORE • BIRMINGHAM • CHICAGO CLEVELAND • DALLAS • DAYTON • DENVER DETROIT • FT. WAYNE • HARTFORD • LOS ANGELES • LOUISVILLE • MILWAUKEE MINNEAPOLIS • NEW ORLEANS • PITTSBURGH • ROCHESTER • SAN FRANCISCO SAVANNAH • SEATTLE • ST. LOUIS MONTREAL • TORONTO
Export Department: CLEVELAND

With Hansen couplings you save precious minutes every time you connect or disconnect a fluid line carrying gas, liquid or grease.

To connect, you merely push plug into socket—flow starts instantly. To disconnect, pull back sleeve on socket, coupling disconnects. Flow is shut off instantly and automatically.

From a wide range of available sizes and types, you can select a Hansen coupling exactly suitable for your application—each type engineered to meet its specific requirements.

QUICK CONNECTIVE FLUID LINE COUPLINGS...

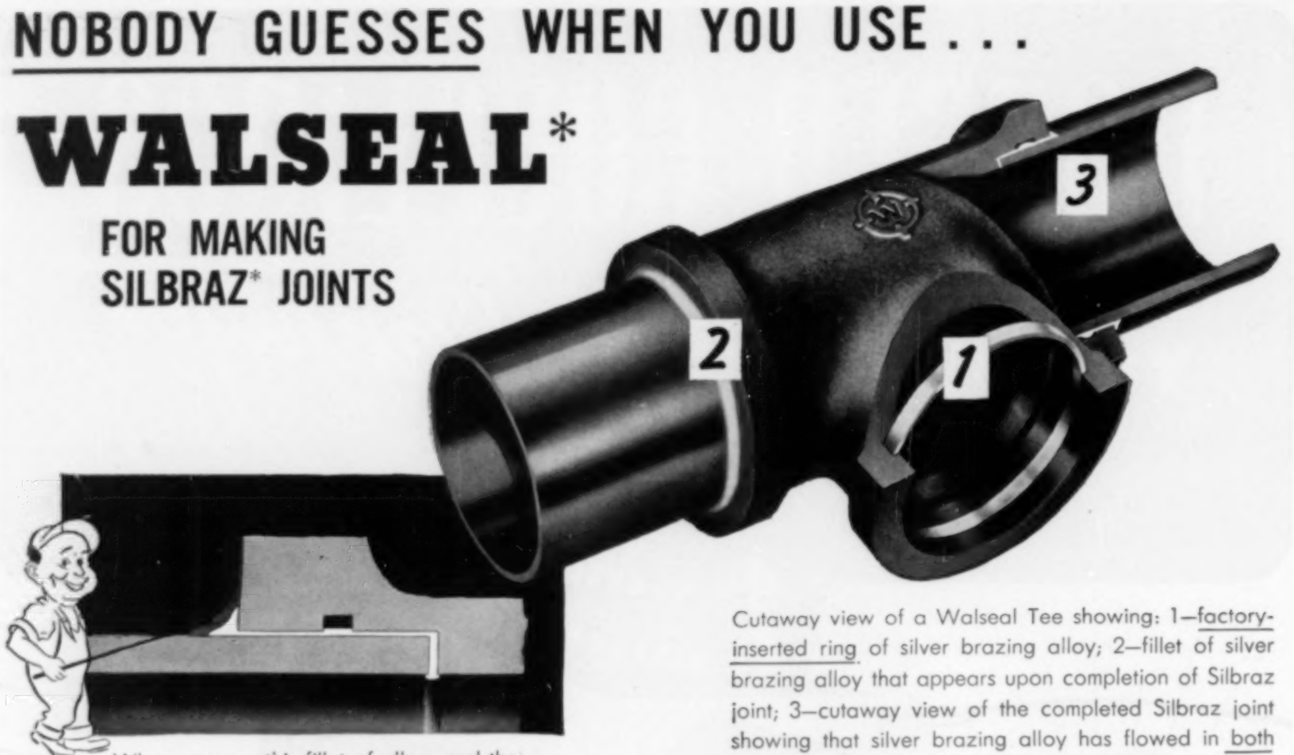
THE HANSEN MANUFACTURING COMPANY

4031 WEST 150th STREET • CLEVELAND 11, OHIO

NOBODY GUESSES WHEN YOU USE . . .

WALSEAL*

FOR MAKING SILBRAZ* JOINTS



When you see this fillet of alloy, and the fitting is Walseal you know that you have penetration because the alloy comes from the inside.

Cutaway view of a Walseal Tee showing: 1—factory-inserted ring of silver brazing alloy; 2—fillet of silver brazing alloy that appears upon completion of Silbraz joint; 3—cutaway view of the completed Silbraz joint showing that silver brazing alloy has flowed in both directions from the factory inserted ring.

When you make Silbraz* joints in your brass, copper, or copper-nickel pipe lines with Walseal Valves, Fittings, or Flanges you know you have the right amount of the correct type of silver brazing alloy. The ring of Sil-Fos brazing alloy is factory-inserted in the ports of Walseal products at the time of manufacture.

No lost time or motion in handling the alloy . . . no difficulty in getting full penetration of the alloy regardless of the position of the valve or fitting . . . no guessing whether the joint is made right . . . the fillet of alloy that shows up when the Silbraz joint is completed, comes from the inside!! And, whether you've made the Silbraz joint yourself, or inspecting the work of another, you know that if the silver alloy fillet is visible, and the valve or fitting is Walseal, you have full penetration. That's why nobody guesses when you use Walseal!

Walseal products are backed by the reputation of the Walworth Company, manufacturers of valves and pipe fittings since 1842.

For full information regarding Silbraz joints made with Walseal products, write for Circular 84.

**Patented—Reg. U. S. Pat. Off.*

Recommended for

- **Hot and Cold Water Circulating Systems**
- **Boiler Feed Lines**
- **Steam Return Lines**
- **Condensate Lines**
- **Low and High Pressure Air Systems**
- **Lubricating Oil Circulating Systems**
- **Industrial Gas Piping**
- **Solvent and Vacuum Piping Systems**

Make it "a one-piece pipe line" with WALSEAL

WALWORTH
valves and fittings
60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

THEY'RE FLEXIBLE
TOUGH
RESILIENT, TOO

GARLOCK METAL FOIL PACKINGS

Garlock Metal Foil Packings are specially designed for service on rods or shafts of equipment operating at high speeds and high temperatures.

They are constructed of thin metal foil spirally wrapped around a fibrous center core. Thus, the durability of metal wearing surfaces is combined with the resiliency of a fibrous packing.

The packings described at the right have a patented, pleated foil construction which makes them remarkably flexible and permits the forming of rings without undue distortion of the material. Also, the many small pockets in the pleats of the foil carry lubricant to the wearing surfaces of the packing. Write for descriptive folder.

COPPER Garlock 906—Pleated copper foil with asbestos core for steam, air or gases (except ammonia) and hot oils of low sulphur content, at temperatures up to 1000° F.

ALUMINUM Garlock 913—Pleated aluminum foil with asbestos core for hot oils at temperatures up to 1000° F.

LEAD Garlock 917—Pleated lead foil with asbestos core for steam, air, oil, water, ammonia or other gases at temperatures up to 550° F.

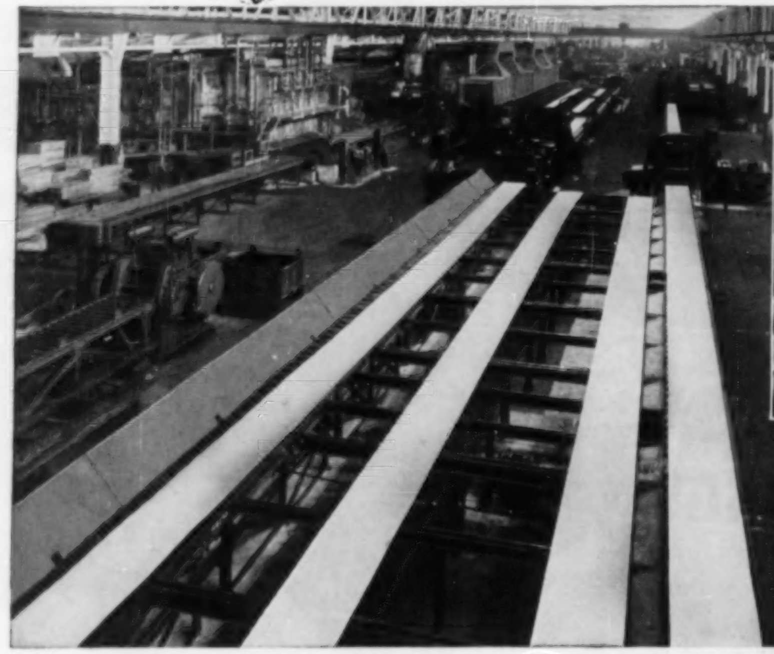
THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

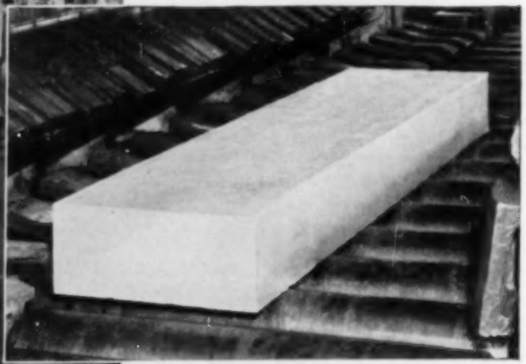
In Canada: The Garlock Packing Company
of Canada Ltd., Toronto, Ont.

GARLOCK

PACKINGS, GASKETS
AND OIL SEALS

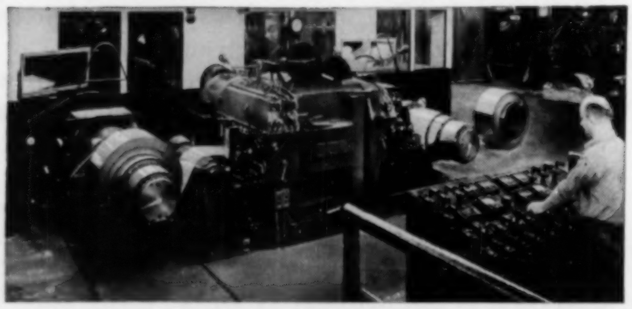
Industrial Improvement *Keeps America Strong!*





Above—3,300 lb. heated brass casting, ready for hot rolling. At left are shown the long brass bars after breakdown rolling.

Below—Finish rolling brass strip on new Sendzimir mill. Operating at high speeds, this mill produces bright, clean finished coils weighing up to 2,400 lb.



You don't defend freedom by sitting tight on your status quo

American Industry knows it must continue to improve and modernize, advance and expand. There is no other way to meet the grim challenge of mobilization.

The nation's metalworking industries have buckled down to the job of defense production. Anaconda helps them keep step with latest technical advances by continuing its intensive program of mill modernization.

One of the first projects completed in our mill improvement program is the new strip mill at the Buffalo Branch of The American Brass Company. This mill now produces longer and wider coils of brass strip from 3,300 lb. castings (13 times as heavy as could be handled before). These long, joint-free lengths of brass strip are made to remarkably close gage and have an exceptionally bright, clean finish.

Anaconda Copper, Brass and Bronze are in the front line of America's defense program. When world freedom and justice have been secured, these mighty metals will turn to peacetime tasks. Anaconda is thus serving tomorrow's needs as well as today's.

51321A

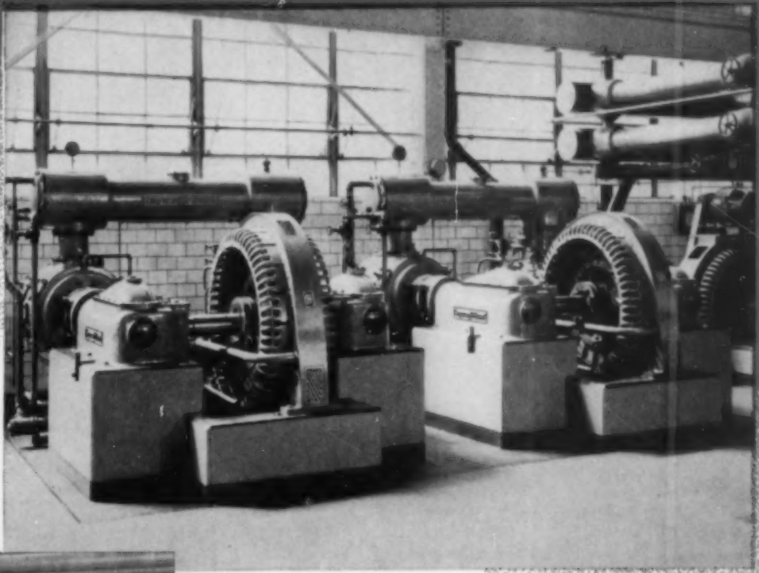
ANACONDA®

First in Copper, Brass and Bronze

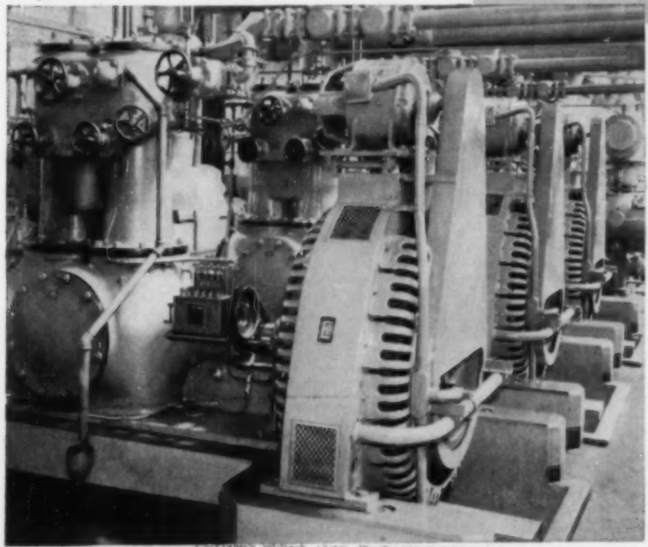
The American Brass Company
Anaconda Wire & Cable Company
International Smelting and Refining Company
Andes Copper Mining Company
Chile Copper Company
Greene Cananea Copper Company

High Power Factor maintained with ELLIOTT *SYNCHRONOUS* MOTORS

Photo at right shows two Elliott 125-hp, 360-rpm motors driving air compressors. The off-center mounting of motor between the two compressor cylinders allows for stator shift. Motors have split rotors. Exciters are belt-driven, floor mounted.



Three Elliott 175-hp, 360-rpm synchronous motors with top-mounted exciters drive the refrigeration compressors. Necessary Wk^2 has been incorporated in the motor design to eliminate necessity of separate flywheel.



Falls City Brewing Company, Louisville, Ky., in building a fine new power plant, selected Elliott synchronous motors for driving compressors. In addition to high power-factor maintenance, these motors, with their efficient "Fabri-Steel" design and construction, allow for the greatest flexibility in installation. Note, too, the attractive appearance of these installations—another indication of engineering excellence. Check on these popular Elliott synchronous motors for your next application. Write for bulletin PB5000-1 today.

Elliott
FABRI-STEEL
MOTORS AND GENERATORS

L-811

ELLIOTT COMPANY
DEPT. CA
RIDGWAY DIVISION • RIDGWAY, PA.
JEANNETTE, PA. . RIDGWAY, PA. . AMPERE, N. J. . SPRINGFIELD, O. . NEWARK, N. J.
District Offices in Principal Cities

HALF CENTURY OF POWER PROGRESS 1901 E Co. 1951

72

101

Yes, 72 out of 101
Machine Tool Builders*
use SKF BEARINGS.

This acceptance of SKF Bearings to help provide the highest accuracy under severe conditions is typical of SKF's acceptance by *all* industry.

7167

8 REASONS
WHY SKF
IS PREFERRED
BY ALL INDUSTRY

- integrity
- craftsmanship
- metallurgy
- tolerance control
- surface finish
- product uniformity
- engineering service
- field service

SKF
BALL AND ROLLER BEARINGS

SKF INDUSTRIES, INC., PHILADELPHIA 32, PENNA.
-manufacturers of SKF *and* HESS-BRIGHT *Bearings.*

*Major manufacturers of metal turning and metal removing equipment.

WHEN POWELL VALVES GO IN, MAINTENANCE GOES OUT!

With today's urgent need for maximum production, why take a chance on any valves that require constant attention?

By installing Powell Valves—built for perfect performance with minimum maintenance—you can stop worrying about your flow control equipment.

Gate, Check, Globe and Y Valves, in Bronze, Iron, Steel and Corrosion-Resisting Metals and Alloys

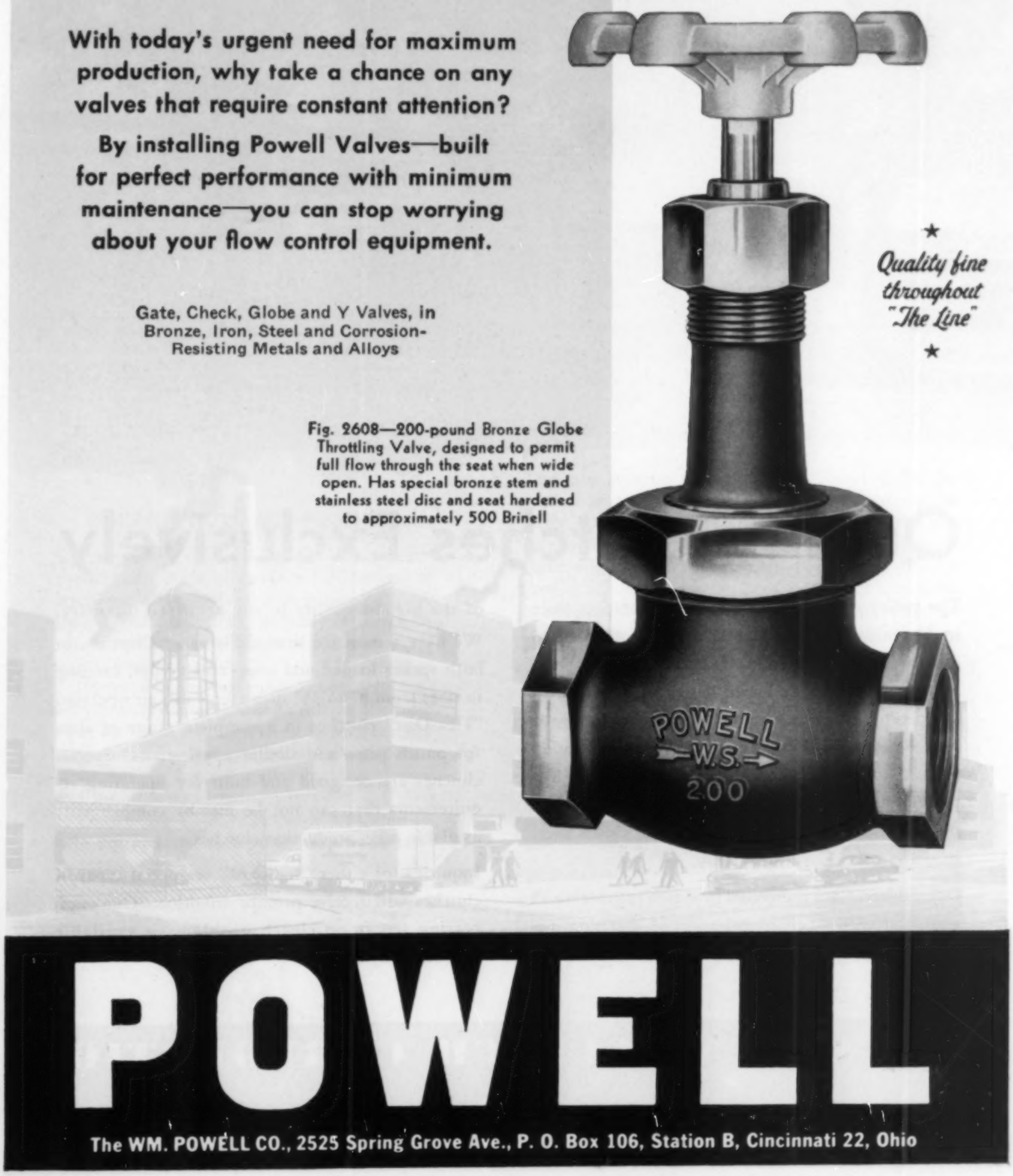


Fig. 2608—200-pound Bronze Globe Throttling Valve, designed to permit full flow through the seat when wide open. Has special bronze stem and stainless steel disc and seat hardened to approximately 500 Brinell

★
Quality fine throughout "The Line"
★

POWELL

The WM. POWELL CO., 2525 Spring Grove Ave., P. O. Box 106, Station B, Cincinnati 22, Ohio

INDUSTRIAL CLUTCH CORPORATION

Quality Clutches Exclusively

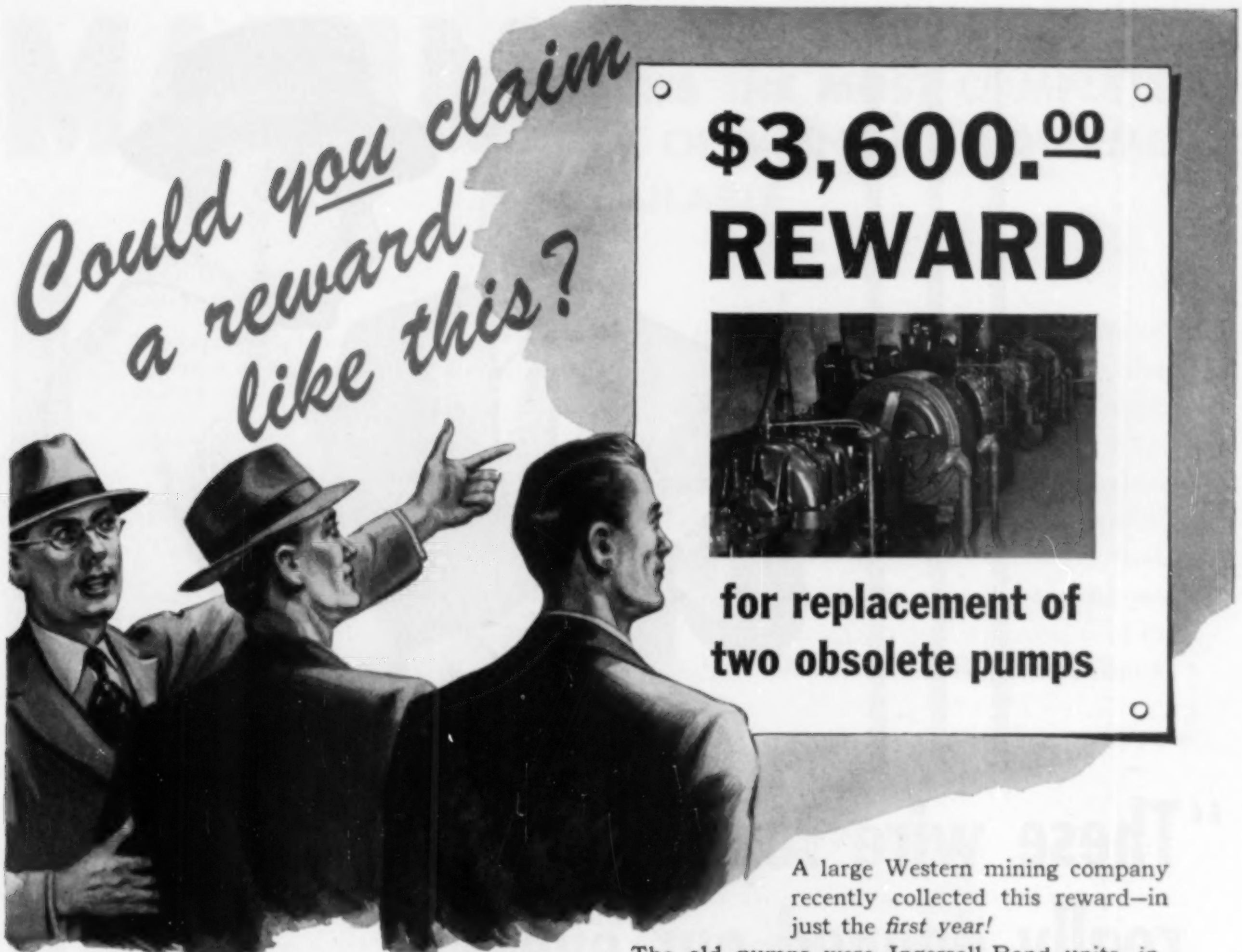
The policy of Industrial Clutch Corporation since its inception 21 years ago has constantly been to design and build only the best clutches that engineering experience and a skilled group of workmen could produce, and to price such clutches as low as was consistent with high quality. We have steadily refused to sacrifice quality for the sake of a low price and, therefore, our product and services appeal primarily to those discriminating clutch users who appreciate superior quality.

Our modern plant is directed by clutch engineers and equipped with a full complement of precision machine tools, jigs and fixtures for producing clutches of the highest quality in any required quantity. We have a standard line of Flex-Disc Clutches, in both spring loaded and over-center types, ranging in sizes from 8″ to 35″ diameter—also air operated "Flex-Disc" clutches in a complete range of sizes for punch press and similar applications. Special clutches are designed and built for operating requirements that can not be met by commercially available mass production clutches.

Inquiries for either "standard" or special types of clutches will receive prompt attention. Our engineering service on clutch problems is available without obligation.

INDUSTRIAL CLUTCH CORPORATION

Waukesha Wisconsin


Could you claim a reward like this?
$3,600.00
REWARD
for replacement of two obsolete pumps

A large Western mining company recently collected this reward—in just the *first year!*

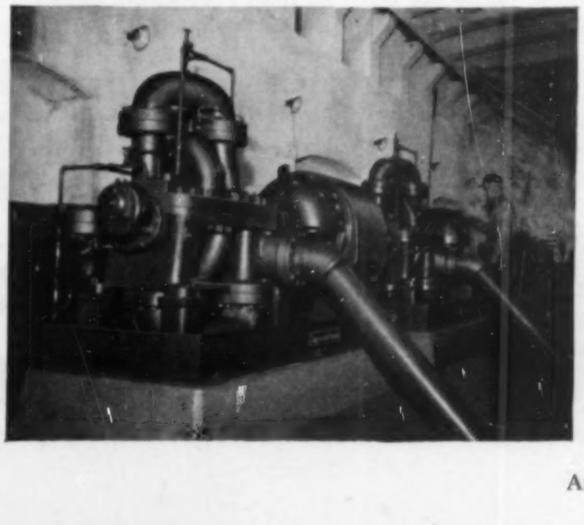
The old pumps were Ingersoll-Rand units, installed at the 1200-foot level for mine drainage. After 18 years of service, these pumps were still in excellent condition—still operating at close to their original efficiency. *But*—because of the far greater efficiency and reduced power requirements of modern I-R pumps, it was decided to retire the two old units. They were replaced with the two I-R Type RT pumps shown below. And immediately the power bill dropped from $1100 a month to less than $800 a month—a saving of $3600 a year in power consumption alone. Substantial savings in maintenance costs were an added "bonus"—making this one of the most profitable equipment investments the company ever made.

CHECK YOUR OLD PUMPS—

Compare their efficiency and power requirements with those of *modern* I-R pumps of equal capacity. You may be amazed at how much you can actually *save* by retiring obsolete equipment—regardless of how well it still is functioning.

Ingersoll-Rand has made substantial improvements in pump design during the past 20 or 30 years. And it is these improvements—in efficiency and performance—that can make such a big difference in your power and maintenance costs.

Your nearest I-R engineer will be glad to help you determine if you have any pumps in service that can profitably be replaced by modern units. Why not get in touch with him today?



Ingersoll-Rand
CAMERON PUMP DIVISION
11 BROADWAY, NEW YORK 4, N. Y.

501-10

"These wire rope figures really opened our eyes!"

"Couple of years ago, the boss asked me to start checking our wire rope costs. He wanted a little system of records that would tell us what each rope was doing, and how much work we were actually getting from it. Figured we could learn the brand that would last the longest—and cost the least—on our type of work.

"So I started keeping track. In our case, the jobs involving rope boiled down to a matter of tonnages moved. Wasn't at all hard to record what each rope accounted for in its lifetime. When I'd been checking long enough for the figures to have some meaning, I showed 'em to the boss. By then I could tell which make of rope was doing the best job for us, costwise and every way. The figures really opened our eyes!"

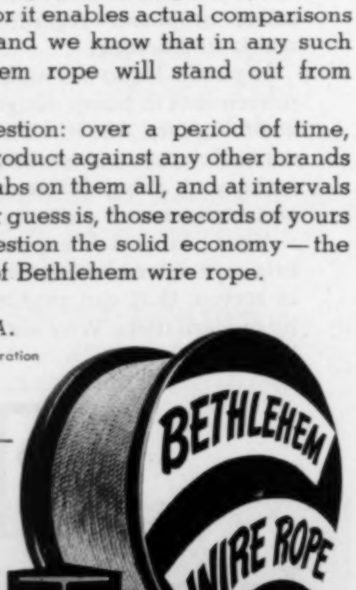
These men weren't the first to learn the value of checking rope performance. Many users of Bethlehem wire rope follow the practice regularly. We're always glad to see it, for it enables actual comparisons between brands . . . and we know that in any such comparisons, Bethlehem rope will stand out from the crowd.

Here's a fair suggestion: over a period of time, stack the Bethlehem product against any other brands of your choice. Keep tabs on them all, and at intervals study your figures. Our guess is, those records of yours will prove beyond question the solid economy — the long-term economy—of Bethlehem wire rope.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

LET YOUR RECORDS TELL YOU!



MAXIM MAKES THE MOST COMPLETE LINE OF SILENCING EQUIPMENT AVAILABLE

EXHAUST AND INTAKE SILENCERS

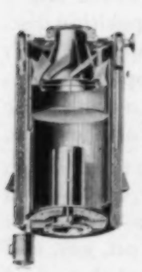
. . . designed to silence the exhaust or intake of internal combustion engines, steam engine exhaust, air compressor intake, vacuum pump discharge and the intake or discharge of blowers.

SPARK ARRESTOR SILENCERS

. . . provide effective silencing of exhaust noise plus 100% spark arresting — for use where fire safety is imperative or where dirt nuisance must be eliminated.

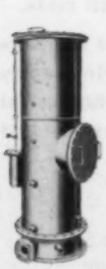
STEAM BLOW-OFF SILENCERS

. . . developed to reduce to a minimum the discharge roar of high velocity steam, air or gas to atmosphere. They are used in installations involving steam safety valve discharges, etc.



HEAT RECOVERY SILENCERS

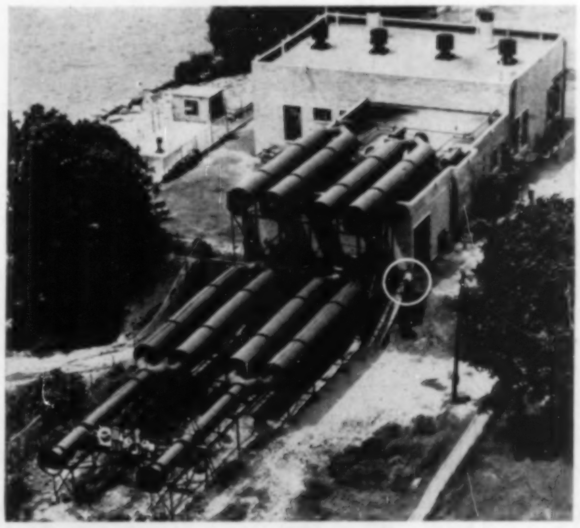
. . . combining efficient silencing of engine exhaust noise with spark arresting (where necessary) and with the efficient recovery of waste exhaust heat to produce steam or hot water for heating or processing operations.



EVAPORATOR DISTILLERS

. . . produce fresh water to a purity of 3½ parts per million from sea water — capacity smallest unit 350 gals. per day. ALL MONEL, high circulation rate means minimum scaling.

The pioneer in the development and manufacture of silencing equipment, Maxim today offers industry the most complete line of silencing equipment available. Longer experience in the silencing field, coupled with progressive research and engineering, have made Maxims the best answer to superior silencing for standard as well as special jobs. Maxim makes motorboat silencers that you can hold in your hand and silencers, for testing jet engines, that fill an entire flat car. There's a good deal in the saying that, "Maxim can silence anything that comes out of a pipe."



These big Maxim Silencers (note size of man in circle) quiet the scream of centrifugal compressors on test stands . . . a tough silencing job that Maxims are handling with quiet efficiency.

Consult MAXIM

THE MAXIM SILENCER COMPANY 61 HOMESTEAD AVE., HARTFORD 1, CONNECTICUT

MAXIM UNIVERSAL SILENCER

Gentlemen: Please send me information on:

☐ Exhaust and Intake Silencers
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Company ______

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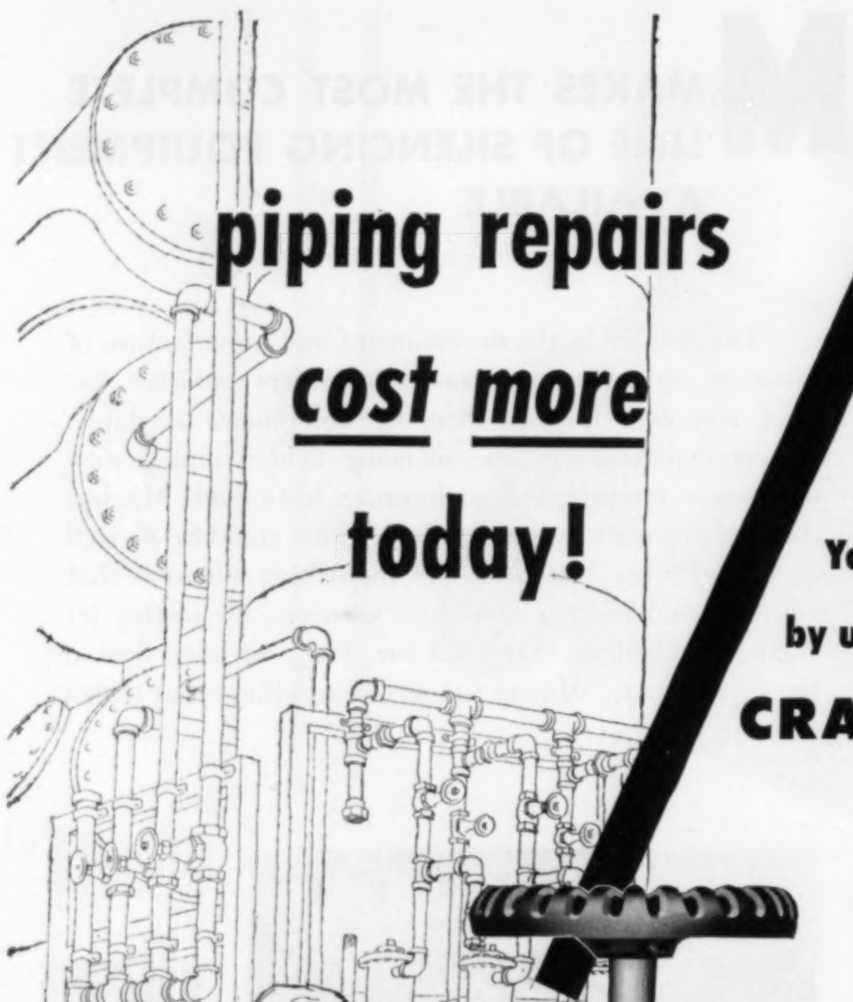
piping repairs cost more today!



Crane No. 7
150-Pound Brass Globe Valve
with composition disc

You spend less

by using Dependable Quality

CRANE VALVES

. . . That's why more Crane Valves are used than any other make

Disc repairs made in a minute

You save maintenance time and money when you use Crane No. 7 Brass Valves with composition disc. When a leak shows up, you don't change valves . . . just open the bonnet joint and slip on a spare disc holder with a new disc already in it.

And by changing the type of disc, you can adapt No. 7 valves to a wide range of services—steam, hot water, cold water, air, oil, gas, and gasoline. Made in globes and angles; screwed or flanged ends.

Simplified maintenance and complete adaptability to your service typify Crane Quality valves and fittings for every need. That's why they cost less in the long run.

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General Offices:
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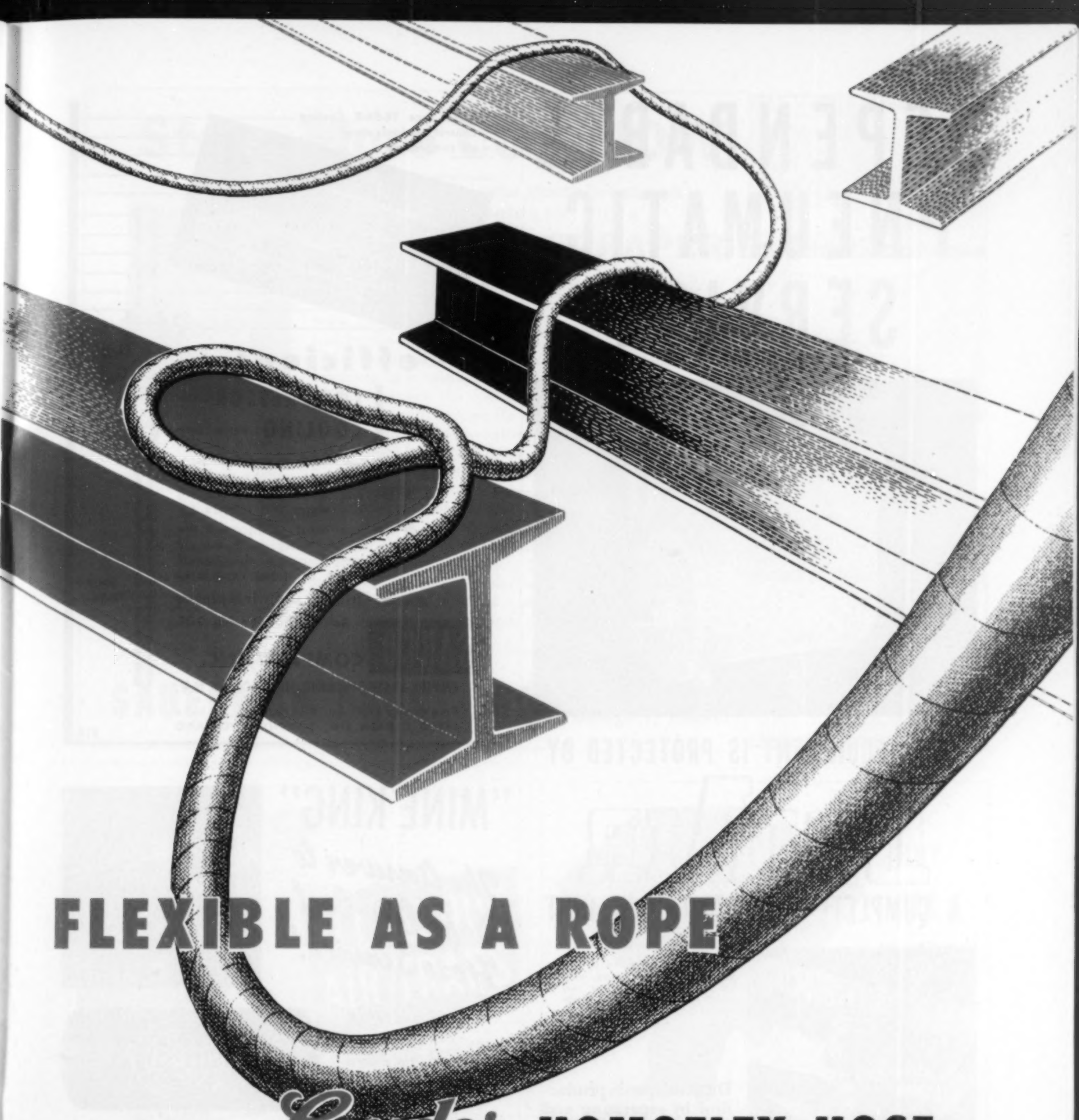
VALVES • FITTINGS • PIPE • PLUMBING • HEATING



FLEXIBLE AS A ROPE

Condor HOMOFLEX HOSE

"Why, this hose is flexible as a rope!" say the men who work with it. • But it's no surprise to us—we engineered it that way. Homoflex has no pre-set twist, it coils and uncoils easily. It doesn't kink or collapse on sharp bends. It's light, but amply strong. It's easy to handle. It's sized uniformly. Workmen like it . . . It lasts longer. • How these advantages are built into Homoflex is in Bulletin 6879 D, mailed on request. • The same engineering goes into our V-belts, flat belting and conveyor belts. Just phone your R/M Distributor.

MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Manufacturers of Mechanical Rubber Products • Rubber Covered Equipment • Radiator Hose • Fan Belts • Brake Linings • Brake Blocks • Clutch Facings • Packings • Asbestos Textiles • Powdered Metal Products • Abrasive and Diamond Wheels • Bowling Balls

DEPENDABLE PNEUMATIC SERVICE

WHEN EQUIPMENT IS PROTECTED BY

DRIAIR

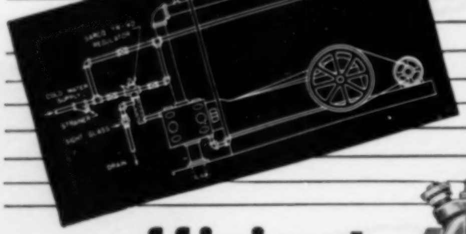
A COMPLETE SELF-CONTAINED UNIT

DriAir may be installed by suspending it from the piping, without any other support, or may stand on the floor near equipment being protected.

DRIAIR speeds production by separating and automatically ejecting the condensed water and oil from the air. DriAir collects dirt and rust from the air lines and delivers clean dry air to the tools, thus reducing wear and prolonging their life. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent. Copy of Bulletin DA fully describing the operation of DriAir sent on request.

NEW JERSEY METER COMPANY
PLAINFIELD, NEW JERSEY

Sarco Type TR-54-R Cooling Control on single stage air compressor



efficient
COMPRESSOR COOLING

- Do you want to avoid over — or under — cooling?
- Do you want to save cooling water and lubricants?
- Do you want to increase the efficiency and life of your air compressor? . . . then install SARCO COOLING CONTROLS

Simple • Self-operated • Inexpensive

Ask for Bulletin No. 701

Sarco TR-54-R

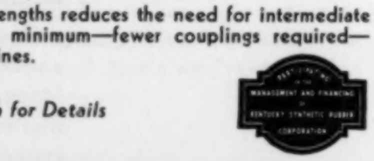
SARCO COMPANY, INC.
EMPIRE STATE BUILDING, NEW YORK 1, N.Y.
Represented in Principal Cities
SARCO CANADA LTD., TORONTO 5, ONTARIO

518

"MINE KING"
The Answer to Safe, Low-Cost Hose Service!

"Standard of Quality"

Sizes ½", ¾" and 1".
Double and Triple Cord.
Max. Lengths of 500'.



Use of "MINE KING" Air Hose assures important economies in drilling operations, regardless of conditions.

Its tougher, more durable construction keeps it on the job longer—a saving in hose replacement costs.

Extreme flexibility provides easier handling and facilitates drilling in tight spots and coiling for transport.

Availability in extra long lengths reduces the need for intermediate connections to an absolute minimum—fewer couplings required—less time for setting up the lines.

PARTICIPATING IN THE MANAGEMENT AND FINANCING OF KENTUCKY SYNTHETIC RUBBER CORPORATION

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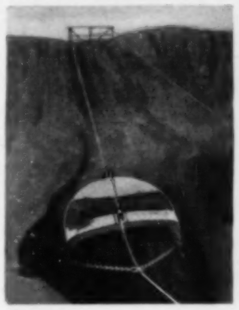
Blocks • Clutch Facings • Packings • Asbestos Textiles • Powdered Metal Products • Abrasive and Diamond Wheels • Bowling Balls

Store More Coal NOW



The "Crescent" scraper bucket pictured above with its load of coal, is an exclusive feature of the Sauerman scraper machine. The "Crescent" requires less line-pull than other types of scrapers to haul a given tonnage and makes the haul in less time. The "Crescent" encloses its load and slides across the pile. It dumps automatically the instant it is pulled backward, and then it returns to the loading point at high speed.

Build larger, safer stockpiles at cost of a few cents a ton with a

SAUERMAN SCRAPER

The trend in coal storage methods, as exemplified by Sauerman Power Scraper systems, features easier work for the operator as well as faster movement of coal by the equipment.

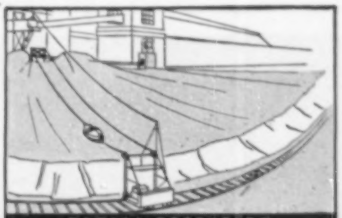
All recent improvements in Sauerman coalhandling machines have reinforced the ability of the scraper operator to spread the coal adequately, to pack the coal uniformly, and to operate effectively in all kinds of weather without inconvenience.

Coal piles built the Sauerman way are insured against spontaneous combustion, because the scraper bucket, in moving across the pile, rakes the fines into the voids, eliminating air pockets and thoroughly compacting the coal. It is the simplest and safest storage method and the most economical. One man, at the head end of the installation, controls every move through automatic switches. He has a comfortable operating station outside the storage area and finds it easy to store or reclaim 30 to 40 scraper loads an hour.

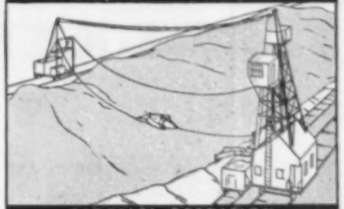
Write for Sauerman Handbook "Storage by Scraper"; 40 pages, illus.

SAUERMAN BROS., INC.

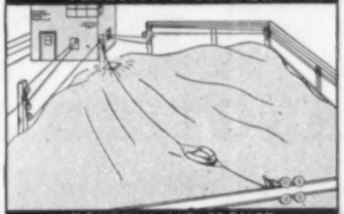
548 S. Clinton St.
Chicago 7, Illinois



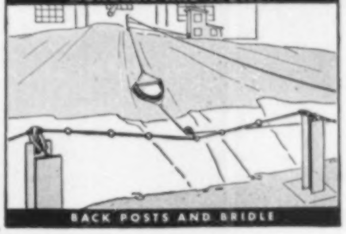
RADIAL OPERATION



PARALLEL OPERATION



MONORAIL AND TROLLEY



BACK POSTS AND BRIDLE

ARMSTRONG Air TRAPS
. . . selection and installation
FOR AUTOMATIC DRAINAGE OF WATER FROM COMPRESSED AIR INTERCOOLERS, AFTERCOOLERS, RECEIVERS, SEPARATORS AND DRIP POINTS
ARMSTRONG MACHINE WORKS
Three Rivers, Michigan
ALL ABOUT AIR TRAPS

SEND FOR THIS NEW BULLETIN

AIR trap selection and installation for automatic drainage of water from compressed air intercoolers, aftercoolers, receivers, separators and drip points are fully described. Helpful sections include typical installation diagrams, illustrations of the various models of Armstrong Air Traps, their applications and operation, and their materials (cast or forged steel bodies and caps, chrome steel valves and seats, stainless steel interior parts). Physical data and list prices complete the story.

There's enough information here for anyone to make the most effective air trap selection for *any* moisture drainage job, any pressure or capacity range. FOR YOUR COPY, WRITE:

ARMSTRONG MACHINE WORKS
885 Maple Street Three Rivers, Michigan

CAMERON HYDRAULIC DATA
CAMERON PUMP OPERATORS' DATA

BUY ALL THREE FOR ONLY $6.00

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Any Combination at Proportionate Savings

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☐ Compressed Air Data and Cameron Pump Operators' Data Both books for $4.50.
☐ Enclosed is (money order) (check) for $........) ☐ Send books C.O.D. I understand that the books will be sent me postpaid, and that they may be returned within 10 days if not satisfactory.

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Company ....
Street No. ....
City .... State .... County ....

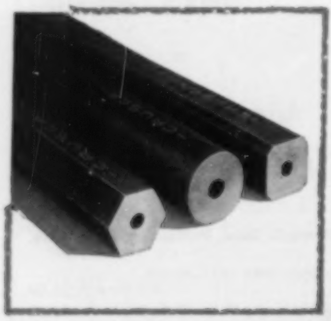
DRILLING
OUT
HARD
ROCK

ANOTHER JOB for HOLLOW DRILL STEEL

When you're up against a tough, hard-rock drilling operation, set up your drills with Crucible Hollow Drill Steel. This quality steel is built to take the punishment of around-the-clock operation of modern, high air-pressure rock drills. And you have the assurance of minimum breakage . . . and an end to loss of expensive bits.

That's because *every* lot of Crucible Hollow Drill Steel is *pretested* before it gets to you. What's more, Crucible Hollow Drill Steel is backed by the experience of engineers and metallurgists who are drill steel specialists. They work right on the job with you . . . if you need them.

You get all these extras when you do business with Crucible. Our metallurgists and drill steel experts can help you with these "special" jobs that take something different in drill steels. CRUCIBLE STEEL COMPANY OF AMERICA, General Sales and Operating Offices, Oliver Building, Pittsburgh, Pennsylvania.



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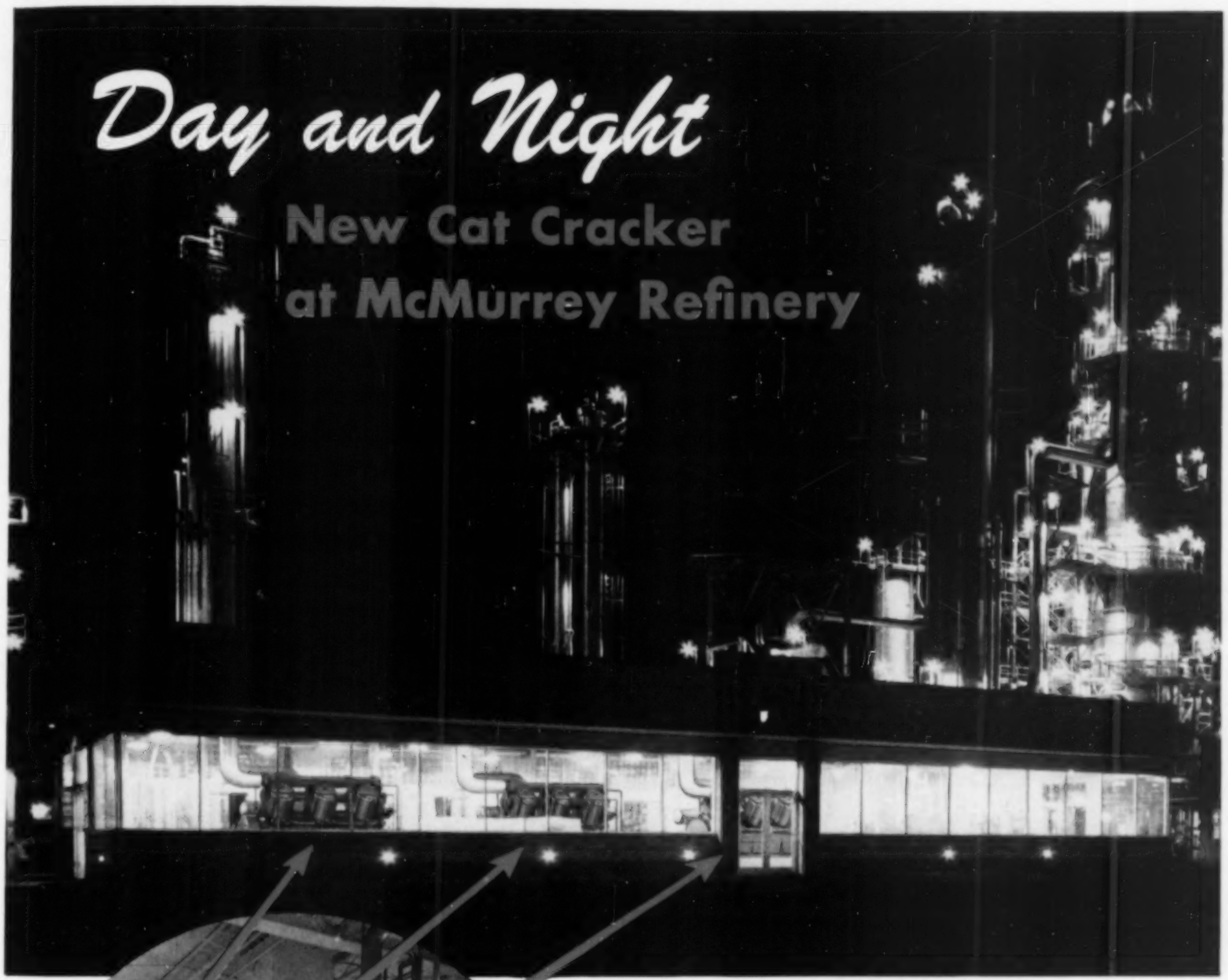
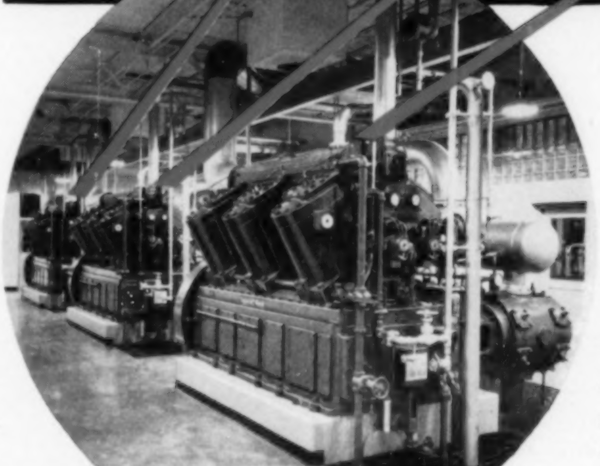
51 *years of Fine steelmaking*

HOLLOW DRILL STEEL

HIGH SPEED • TOOL • STAINLESS • ALLOY • MACHINERY • SPECIAL PURPOSE STEELS





Uses SVG

Gas-Engine-Driven COMPRESSORS for Gas Concentration

The new U.O.P. fluid catalytic cracking unit recently installed at the McMurrey Refinery, Tyler, Texas, gives this progressive oil company an added capacity of 4000 barrels of charge stock per day. To assure uninterrupted service, night and day, year after year, every item of associated equipment has to meet the highest standards of dependability, performance and economy.

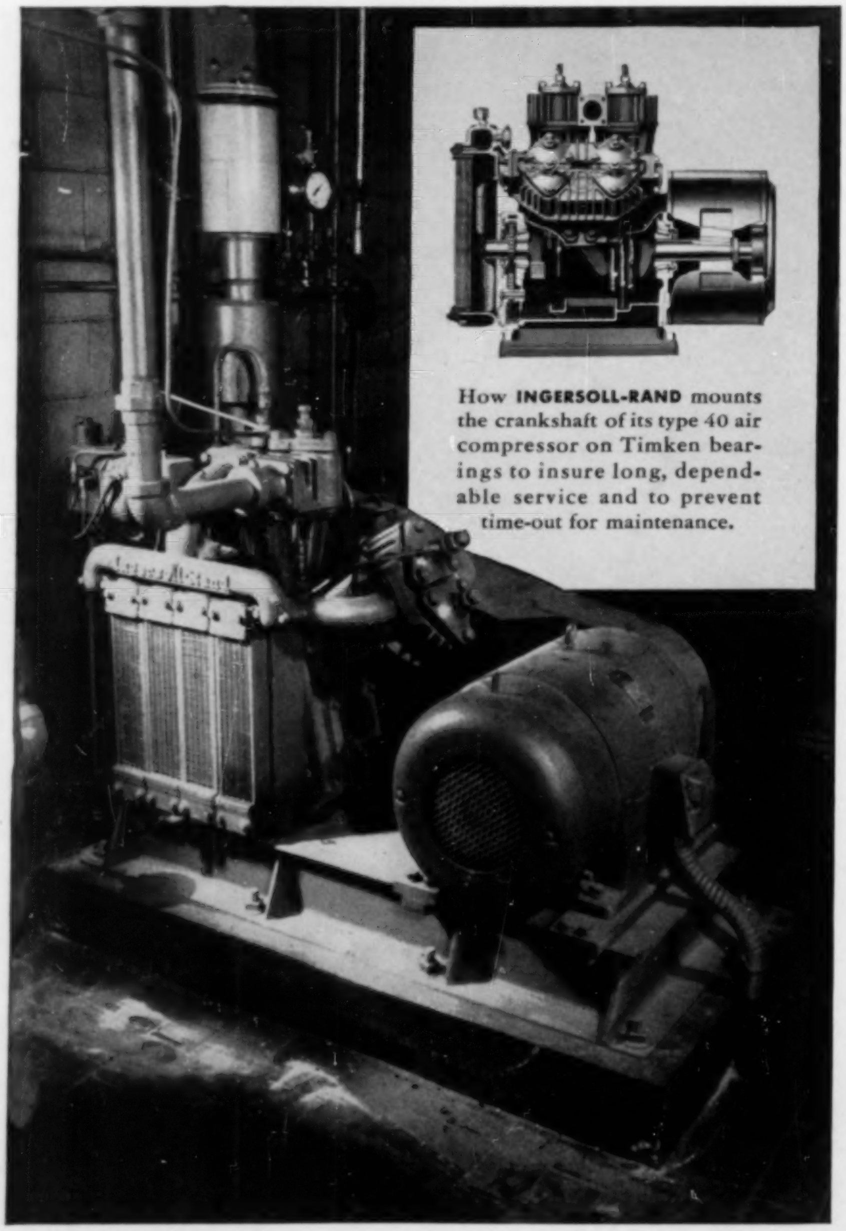
The gas-concentration compressors selected for this important job are three Ingersoll-Rand Type SVG gas-engine-driven units. The SVG, also built in 440-hp size, is the new machine that is essentially a modernized version of the famous XVG. Let us tell you more about the SVG, and other sizes in the I-R 4-cycle line . . . gas engine compressors from 110 hp to 1320 hp . . . gas engines to 1760 hp.

Ingersoll-Rand
11 BROADWAY, NEW YORK 4, N. Y.

693-6

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • DIESEL AND GAS ENGINES

Drug plant compressor stays healthy on TIMKEN® bearings



How **INGERSOLL-RAND** mounts the crankshaft of its type 40 air compressor on Timken bearings to insure long, dependable service and to prevent time-out for maintenance.

THE Ingersoll-Rand type 40 compressor below provides house and instrument air at the Lederle Laboratories Division of the American Cyanamid Company, Pearl River, New York. To keep the compressor in top operating shape, with minimum time-out for maintenance, Ingersoll-Rand mounts the crankshaft on Timken® bearings.

Timken bearings carry both radial and thrust loads in any combination, due to their tapered design. Shafts and adjacent parts are held in positive alignment. As a result, there's less wear on moving parts and less chance of trouble.

Maintenance and lubrication time and cost are kept to a minimum because Timken bearings make closures more effective by holding shaft and housing concentric. Lubricant is kept in—dirt and moisture are kept out. Due to line contact between the rollers and races, Timken bearings have extra load-carrying capacity. Their true rolling motion and incredibly smooth surface finish practically eliminate friction.

Since Timken bearings are precision manufactured, engineered for the job and made of Timken fine alloy steel, they normally last the life of the machine.

If you're looking for dependable, low-cost operation and long life in the machines you make or use, always be sure they have Timken bearings. Look for the trade-mark "Timken" on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.

FINISHED TO CLOSER TOLERANCES

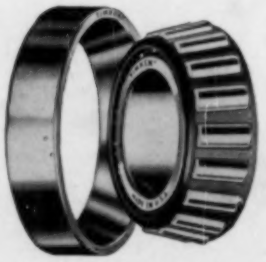
Finishing to incredible smoothness accounts for much of the precise, smooth rolling performance of Timken bearings. This honing operation is typical of the amazingly accurate manufacturing methods at the Timken Company.

The Timken Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



NOT JUST A BALL NOT JUST A ROLLER THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION